AUTOMOTIVE and Aviation INDUSTRIES

FEB 19 1942

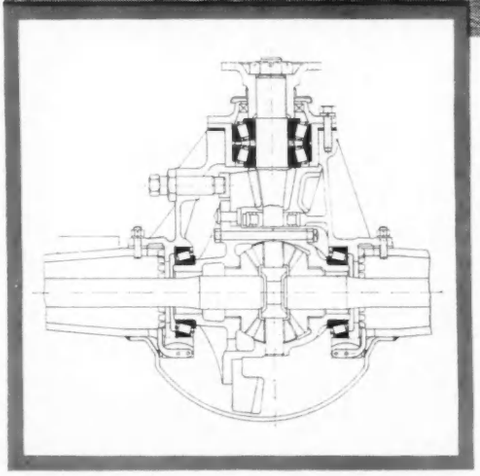
FEBRUARY 15, 1942

The single reduction Timken Bearing Equipped Axle shown here is used in this Model WA 20 truck manufactured by the White Motor Company.

TRUCKS, FLEETS OF THEM,

must keep on the job of delivering the nation's goods until the war is won. The application of Timken Bearings in trucks of all kinds assures complete command of anti-friction bearing responsibility. This was the case before the war, is now and will be after Victory.

Tapered Roller TIMKEN BEARING EQUIPPED



Rugged simplicity of this Timken Bearing Equipped single reduction, straddle mount rear axle means miles of trouble-free service. Assembly and initial adjustment of the Timken pinion Bearings are easy, for the bearings are mounted in a cartridge; this also assures precise gear tooth contact in the pinion. The differential bearings are backed by nuts which make it possible to shift the differential for proper ring gear contact.

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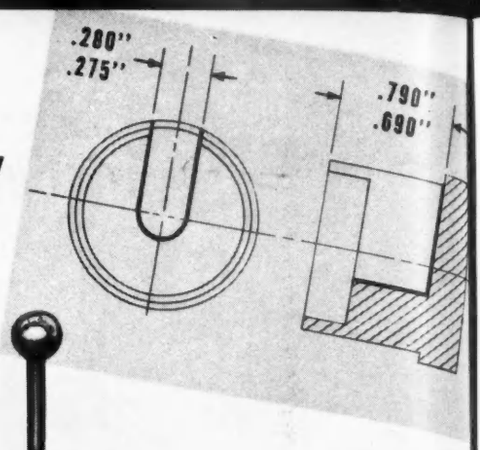

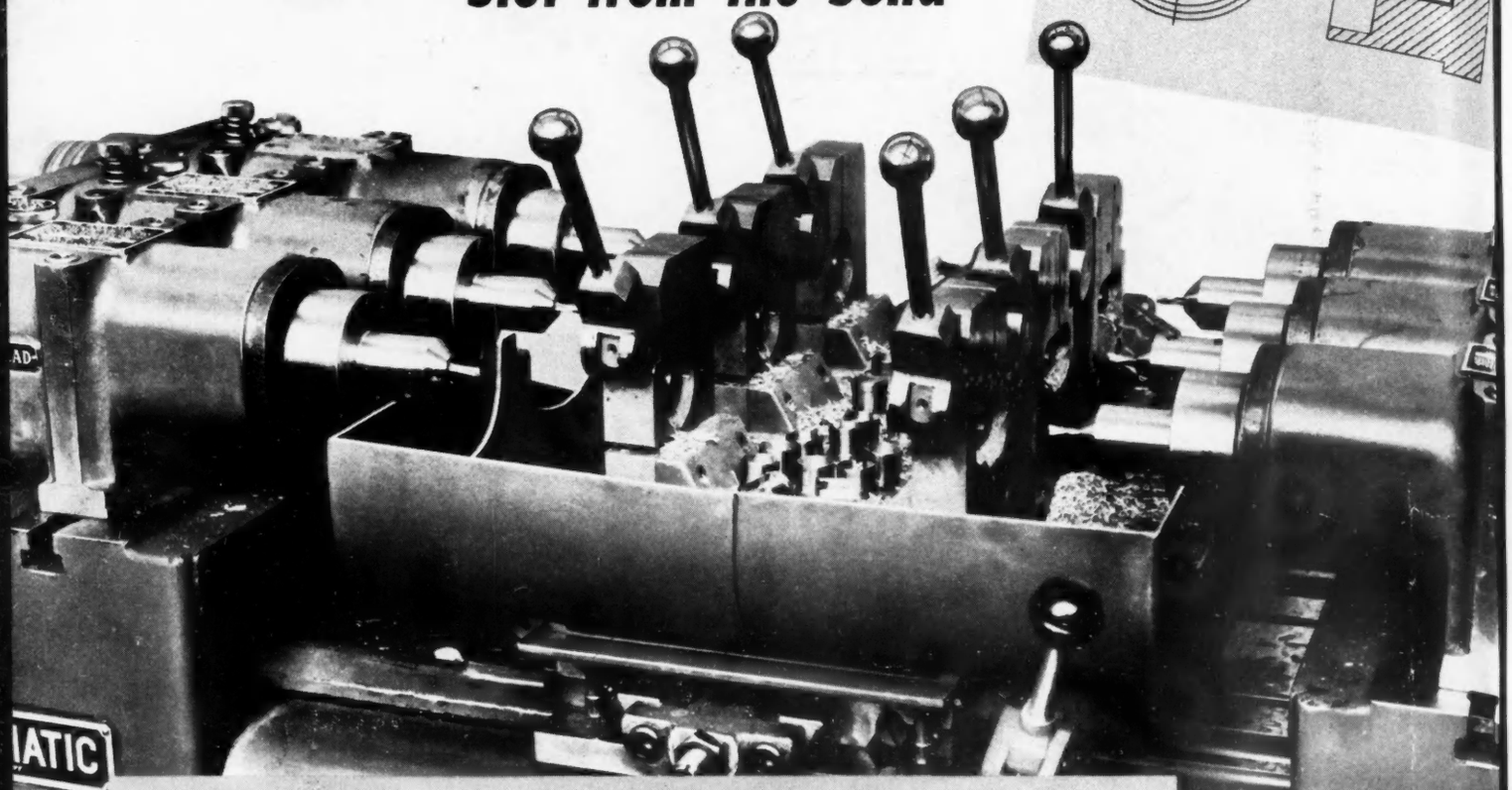

Heald Bore-Matic *plus* Heald tooling boosts production to *600 per hour* on shell fuse parts

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AUTOMOTIVE and Aviation INDUSTRIES

Published Semi-Monthly

Volume 86 Number 4

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IN THIS ISSUE . . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 86 February 15, 1942 Number 4

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

New Type Preference Applications Available

March 2 is the effective date for the mandatory use of the new form of application blank for individual preference ratings. These new forms are designated as PD-1A and PD-3A.

The most important feature of the new system of granting individual preference ratings is that these ratings may now be extended to suppliers and sub-suppliers of the original applicant by a simple endorsement on purchase orders.

The Army and Navy have also begun to use a new form of individual preference rating certificate assigning ratings to their orders, and these ratings, on PD-3A forms, will also be extendable by a simple endorsement on purchase orders. The PD-3A application form is issued only by Army and Navy and other authorized procurement officers.

Because of the tremendous printing job involved, the PD-1A applications will not be available in quantity until toward the end of February. Consequently, the older form of PD-1 application may be used until March 2, but ratings granted on PD-1 applications cannot be extended either now or later.

A MESSAGE

TO YOU . . .

Defense Savings Bonds and Stamps give us all a way to take a direct part in building the defenses of our country—an American way to find the billions needed for National Defense.

The United States is today, as it has always been, the best investment in the world. This is an opportunity for each citizen to buy a share in America.

Keeping the Record Straight **17**

This article starts out saying "For months nonsensical criticism has been leveled at industrialists-on-the-job ****** As a result much misinformation has been bandied about." From there the reader is carried through a series of facts and opinions and remarks from sources that one is bound to respect. It settles one big moot question for all time. Read it.

Aircraft Gear Production **20**

This is one of the few times that the production of gearing for aircraft engines has been described, never so completely as in this article. Routings and machines are described together with the different operations. It is revealing. Turn to page 20 now.

Annual Meeting of the Institute of the Aeronautical Sciences **28**

From the far reaches of the country, from the Army, Navy and civil field came technical men in the field of aviation to the Pupin Physics Laboratories in New York. The reports of the meetings comprise a veritable education in themselves as well as bringing one right up to the minute in the new developments and those to come.

What it Takes **32**

Col. John H. Jouett brings to the foreground some facts and figures that are of more than passing interest in these times of unusual effort. Just what all of this production for defense means in down to ground figures is something of an unusual picture.

New deHavilland Propellers **33**

The deHavilland Aircraft Co. have brought out two new propellers. One with four blades and another with six. Most complete drawings are reproduced, as well as a key to the parts and their operation.

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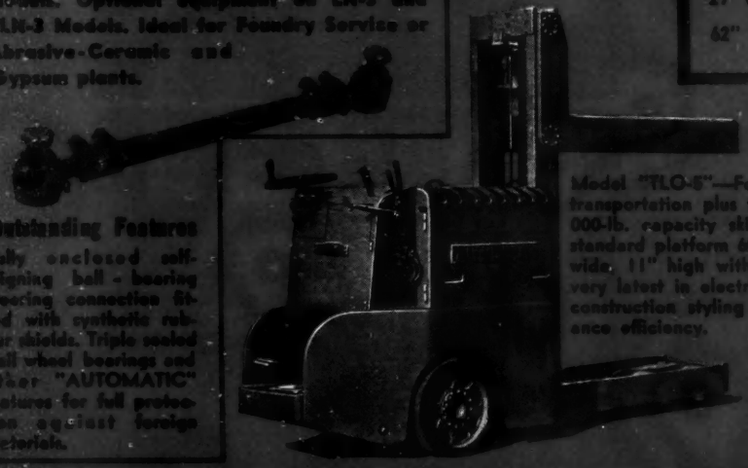

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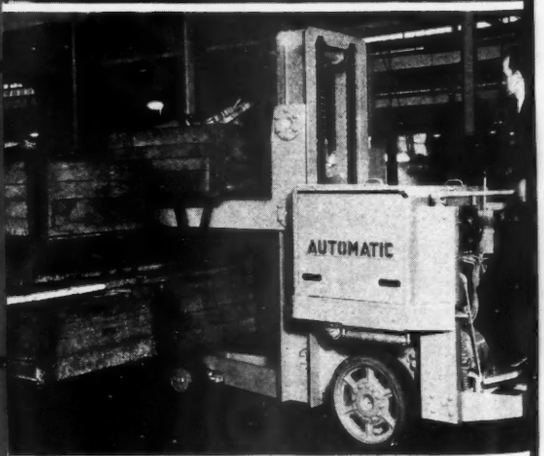

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

Vol. 86, No. 4
February 15, 1942

Keeping the Record Straight

FOR months nonsensical criticism has been leveled at industrialists-on-the-job by politico-economists who set themselves up as experts, but whose experience at the most is only a reading knowledge of manufacturing. As a result much misinformation has been bantied about by some newspaper columnists and radio commentators who know nothing, little if anything, about production, but more about politics and soothsaying.

Mass production has become a highly developed technique in industry, particularly so in making automobiles. Yet those who have made all this possible must be delayed in carrying on to defend themselves against hindsight critics and secondguessers, who would be just as qualified to discuss medicine or jurisprudence.

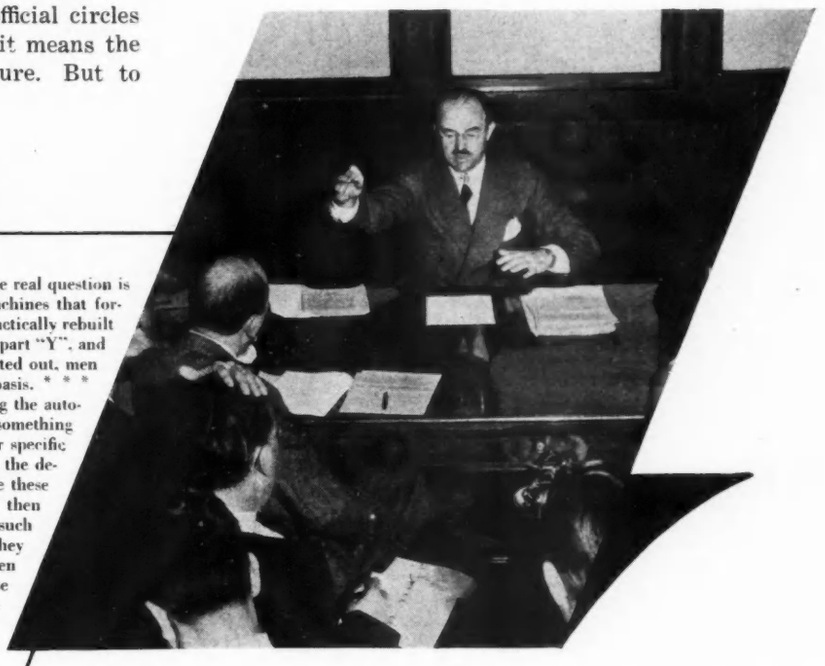
To screen their background, these critics quote from so-called "confidential sources" or use catch phrases, such as "Guns and Butter Both" and "Business-As-Usual." The latter, a double meaning phrase born in Washington, obviously was intended in official circles to stigmatize industry. To the politician it means the continuation of civilian goods manufacture. But to the industrialist it has another meaning—efficiency, coordinated effort and getting the job done. "Guns and Butter Both" needs no comment, time already has interpreted it.

Injection of political expediency into the industrial machine can serve no constructive purpose. The facts should be kept straight, then there will be clear thinking and progress. It must be recognized that the public in general has a laymen's viewpoint of the problems involved in mass production. If everyone understood mass production and what it implies there would be no question as to the why's and wherefore's of the Herculean task of converting the automotive production mechanism from the making of passenger cars and parts to the making of the weapons of war.

Mass production implies the coordination of management brains with machines and with materials

All through the program, the real question is how to get tooled up. The machines that formerly made part "X" must be practically rebuilt or retooled so that they can make part "Y", and then they must all be lined up, tested out, men trained and put on a production basis. * * * There are several stages in converting the automobile industry. First, there must be something to convert to. This means an order for specific parts. After the order is received, then the designs must be made for the tools to make these parts. After the designs are completed, then tools must be actually made according to such designs. When the tools are completed, they must be fitted to the machines. Then men must be brought in and trained to work these machines with their new tools. Finally, the machines will start to produce.

Ernest Kanzler, Chief of the Automotive Branch, War Production Board, Jan. 29, 1942.



Ernest Kanzler meets the press as head of the Automotive Branch of the War Production Board

handling facilities. It is a mechanism possessing great inertia. It takes time to organize; it takes time to tool up; it takes skilled hands to make the tools with which the machines can work. But once it starts rolling, it acquires great momentum and is capable of prodigious effort.

Actually, the automotive industry has had a "conversion" problem each year with the introduction of its yearly models. Only because the process usually is one of evolution in which only styling and moderate mechanical changes are deliberately considered, the advance planning can be done in about nine months of time. But at least that much advance notice is needed in order to prepare the tools and dies and fixtures. This also allows time for the delivery of the new machine tools that may be needed for the program.

Almost 20 years ago, Ford provided a classic example of what is involved if a motor car producer decides to make a revolutionary change in his product. The changeover from the Model T to the Model A took between 12 and 18 months!

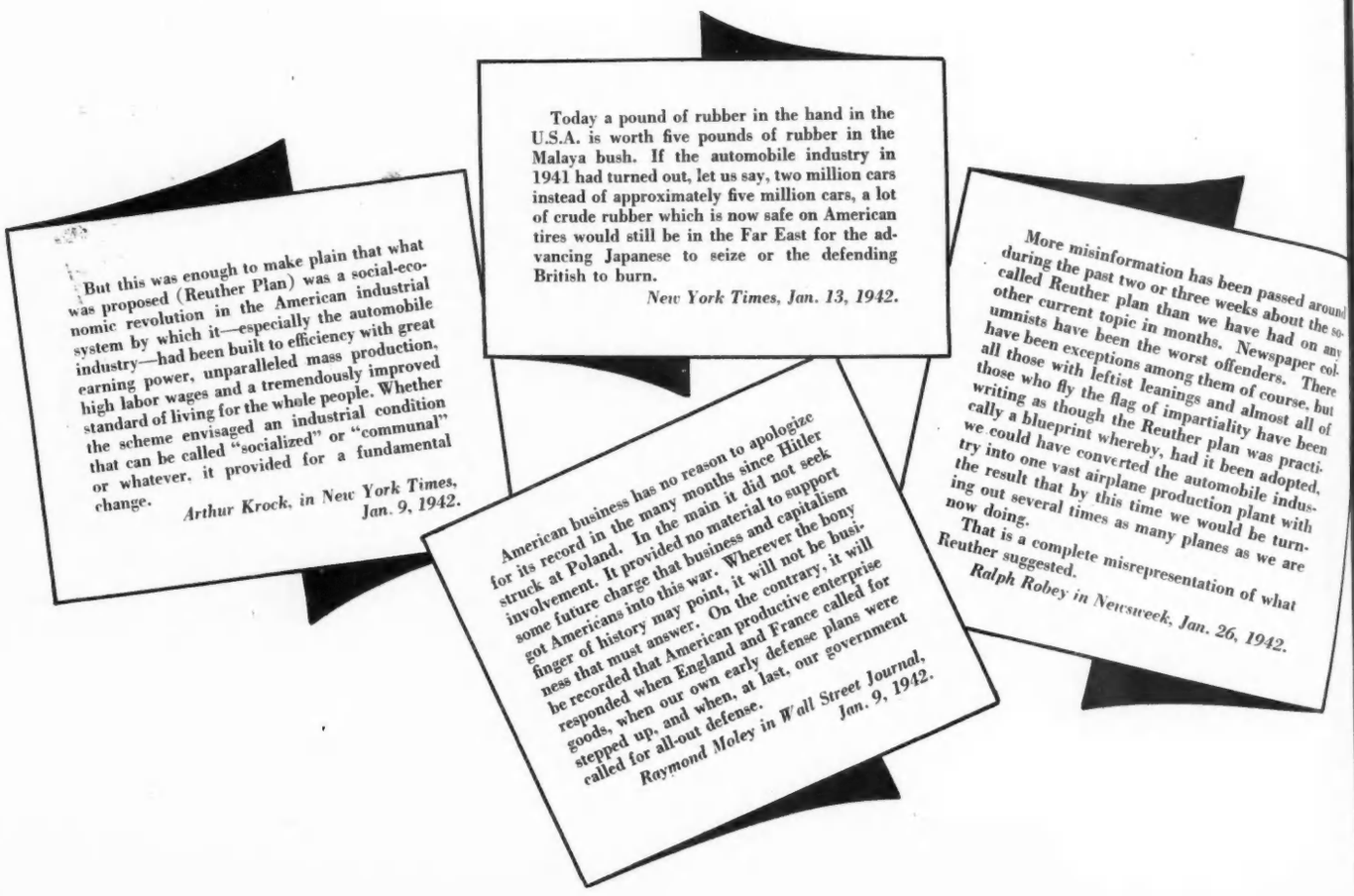
Today the automotive industry is faced with the most revolutionary conversion problem in its entire history. It must change immediately from the making of motor cars and their components to the making of airplane engines, bomber sections and bombers, tanks, shells and cartridge cases, machine guns, and many other things. The question is—how soon can it be done.

The layman's opinion is that the job can be done without any waiting period. There are some who argue that there is no difference between the making of an airplane engine and a passenger car engine. On this assumption they say that most of the machine tools now on the floor can be changed over simply by adding new jigs and fixtures. Unfortunately, the man on the street has gained the impression from people who have influence but do not have the practical background in manufacturing experience.

One of the aspects of the inertia of mass production is that it does not lend itself to frequent changes in product design. Nor does it lend itself to expansion in excess of maximum productive facilities. One may ask what about it. Suppose we take a concrete example, like the Buick airplane engine plant. The order to go ahead with a new plant was given in January, 1941, on the basis of a certain maximum number of engines per month. The building was erected, fitted with machine tools, manned with newly trained labor, and turned out its first engine in January, 1942.

Meanwhile, the war progressed and the military services found it necessary to have still more of the essential weapons. Twice as many engines now were required. The only answer was to commission still another engine plant since the Buick plant had been frozen as to maximum capacity. To this end, General Motors decided to convert a passenger car engine plant near Buffalo for the production of airplane engines.

Here was a concrete instance of what it takes to


But this was enough to make plain that what was proposed (Reuther Plan) was a social-economic revolution in the American industrial system by which it—especially the automobile industry—had been built to efficiency with great earning power, unparalleled mass production, high labor wages and a tremendously improved standard of living for the whole people. Whether the scheme envisaged an industrial condition that can be called "socialized" or "communal" or whatever, it provided for a fundamental change.
Arthur Krock, in New York Times, Jan. 9, 1942.
Today a pound of rubber in the hand in the U.S.A. is worth five pounds of rubber in the Malaya bush. If the automobile industry in 1941 had turned out, let us say, two million cars instead of approximately five million cars, a lot of crude rubber which is now safe on American tires would still be in the Far East for the advancing Japanese to seize or the defending British to burn.
New York Times, Jan. 13, 1942.
American business has no reason to apologize for its record in the many months since Hitler struck at Poland. In the main it did not seek involvement. It provided no material to support some future charge that business and capitalism got Americans into this war. Wherever the bony finger of history may point, it will not be business that must answer. On the contrary, it will be recorded that American productive enterprise responded when England and France called for goods, when our own early defense plans were stepped up, and when, at last, our government called for all-out defense.
Raymond Moley in Wall Street Journal, Jan. 9, 1942.
More misinformation has been passed around during the past two or three weeks about the so-called Reuther plan than we have had on any other current topic in months. Newspaper columnists have been the worst offenders. There have been exceptions among them of course, but all those with leftist leanings and almost all of those who fly the flag of impartiality have been writing as though the Reuther plan was practically a blueprint whereby, had it been adopted, we could have converted the automobile industry into one vast airplane production plant with the result that by this time we would be turning out several times as many planes as we are now doing.
That is a complete misrepresentation of what Reuther suggested.
Ralph Robey in Newsweek, Jan. 26, 1942.

make a conversion of this character. According to figures released by General Motors, the changeover involved an expenditure of $7,849,000 for land and buildings, of which $3,889,000 was provided by the corporation. To produce airplane engines at the desired rate required a total of 3110 machine tools. And of this number, 901 were available from a pool established within the corporation. In this case, it was possible to utilize existing equipment—not all from the same plant—to the extent of about 29 per cent of the total requirement. If only the usable tools in the plant itself were considered, the percentage would be lower. The gigantic task of changing over was begun about six months ago and will take still more time before the first engine is produced on the lines.

Why does it take so long to convert from one job to another? In the answer lies the essence of the mass production system. No doubt it would be quite feasible to improvise a layout using tool room or job shop equipment, and manned by skilled machinists, that could begin to produce any kind of work within a short time. But the present program is one that requires things by the hundreds of thousands and not by the dozen. You can get something in a hurry by job shop methods but remember that the output of the set-up is limited to the few pieces per day it can make right from the start.

Contrast this with mass production. It takes months —six or nine months or even a year—for preparation, for the making of tools, but once this has been done the mass production plant can get out the work in tremendous quantities.

Since Pearl Harbor the cooperative efforts of the industry and the War Production Board have combined to accelerate the process of conversion. By dint of skillful advance planning it will be feasible to do many jobs quickly. For example, the pooling and earmarking of machine tools will make it possible to shift machines to the jobs for which they are best suited. From a technical standpoint there are many reasons why it is not practical to convert blindly from one product to another. In fact, the mass of evidence that we could summon would tax all space limitations. But we can consider one example—the airplane engine.

The fact of the matter is that the resemblance between an airplane engine and a passenger car engine is one of name only; from a manufacturing standpoint there is little resemblance. True, the component parts bear the same names—because of standardization in nomenclature—but they are made of different materials, have different form, are subject to more intensive loading, and demand an entirely different set of specifications as to tolerances and finish.

But there is another difference. Although airplane engine parts are subjected to more intensive loading, they have to be extremely light in weight. This requirement is found to result in long, slender parts which can warp or go out of shape quite readily during the course of any metal cutting operation, unless metal is removed with great care. This means that metal removal has to be slower, and requires more machine set-ups. In contrast, passenger car parts can be machined with the minimum number of cuts and at the highest cutting speeds. Such analysis casts some light on why it is that a Cadillac connecting rod has 20 machine operations while an Allison rod needs 97, requiring 11 man-hours as against 0.2 man-hours on the Cadillac rod.

Although the machine tools used in the making of airplane engine parts are of the same basic types as those used in making passenger car engine parts, there are some striking differences between them. An outstanding difference is that the equipment for making airplane engine parts has to be much more rigid and more massive and larger in size for about the same size of part. The reason for this is that only a heavy,

(*Turn to page* 60, *please*)

The motor executives are charged (by the Truman Committee) with continuing to make cars last year instead of converting their plants to produce war materiel, and the conclusion is drawn that this was due to their placing profits above patriotism.

It may be questioned whether the dislocations that such a switch at that time would have involved, would have benefited the national economy or even the defense effort. Certain it is, however, that had the change been made it would have thrown tens of thousands of workers on the unemployment lists. This consideration, we prefer to believe, was more important to the motor executives than that of profits. In any event, had this unemployment then been created the loudest wails against the employers would probably have emanated from Capitol Hill.

Editorial, Wall Street Journal, Jan. 17, 1942.

Now in the first place, the notion that Mr. Reuther, or the automobile workers, or any one else, has at any time enjoyed a monopoly on the idea of converting the automobile industry to war uses is utterly ridiculous. There never has been the slightest question about such conversion. The only question has been how it could be accomplished most practicably.

Edward H. Collins, Associate Financial Editor, in New York Herald Tribune, Jan. 12, 1942.

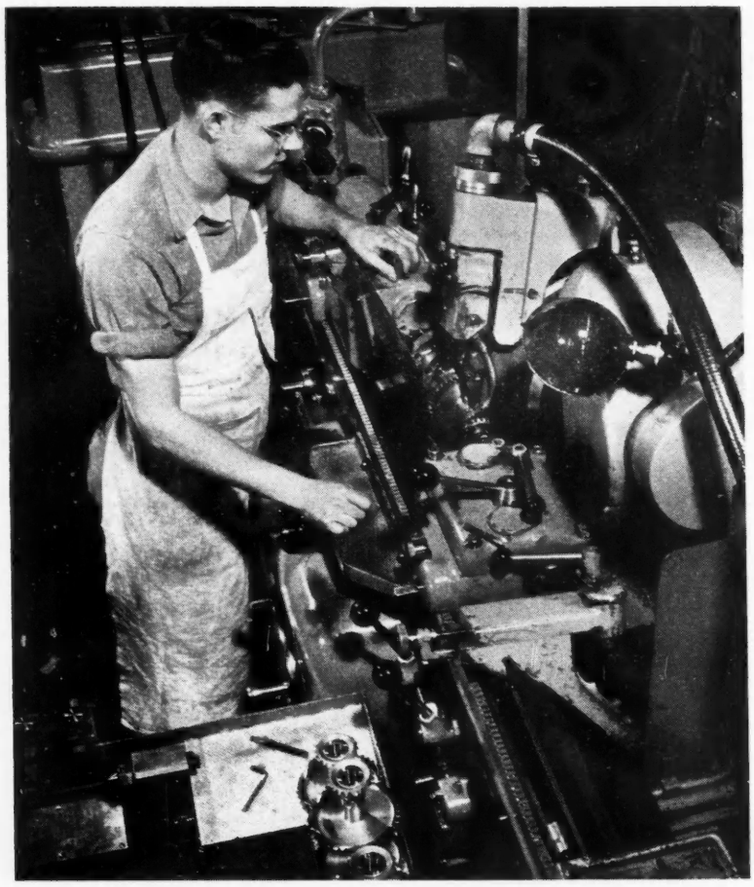
The Administration and automobile labor both insisted also, and quite properly, that any change should be made as smoothly rather than as joltingly as possible. The President declared at a press conference on July 22 that the Administration did not intend to cut off automobile production one day and then not substitute defense work until several months later. On Aug. 3, R. J. Thomas, president of the United Automobile Workers of America, the C.I.O. union, insisted: "Above all, there should be no arbitrary curtailment of automobile production until there is work available on defense projects." But apparently a sufficient volume of defense orders was not placed in time.

Editorial, New York Times, Jan. 19, 1942.

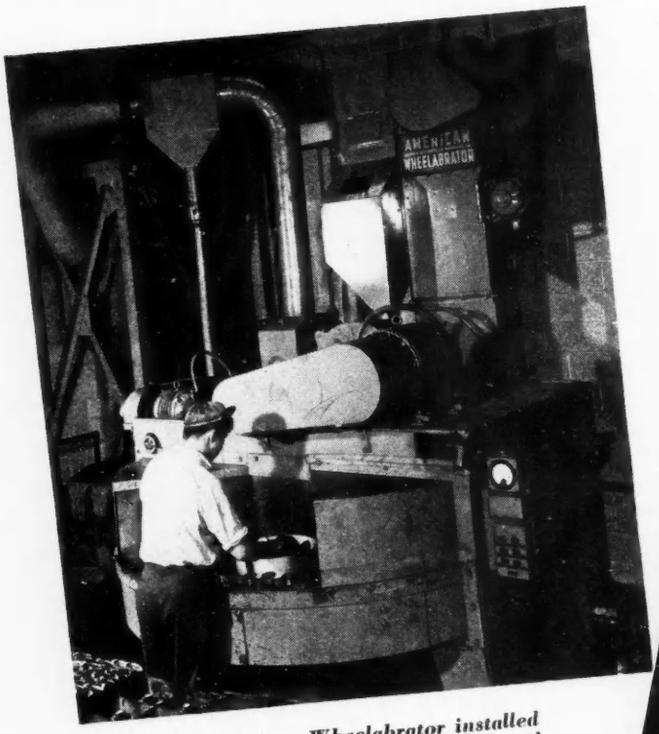
Aircraft G

ALTHOUGH the problems unique to the manufacture of airplane engines for military uses have been discussed on many occasions, this is the first opportunity we have had to touch upon the production of gearing for these engines. The participation of automotive organizations has brought into the picture the accumulated experience of outstanding gear experts who are bringing to bear many of the lessons learned in passenger car practice.

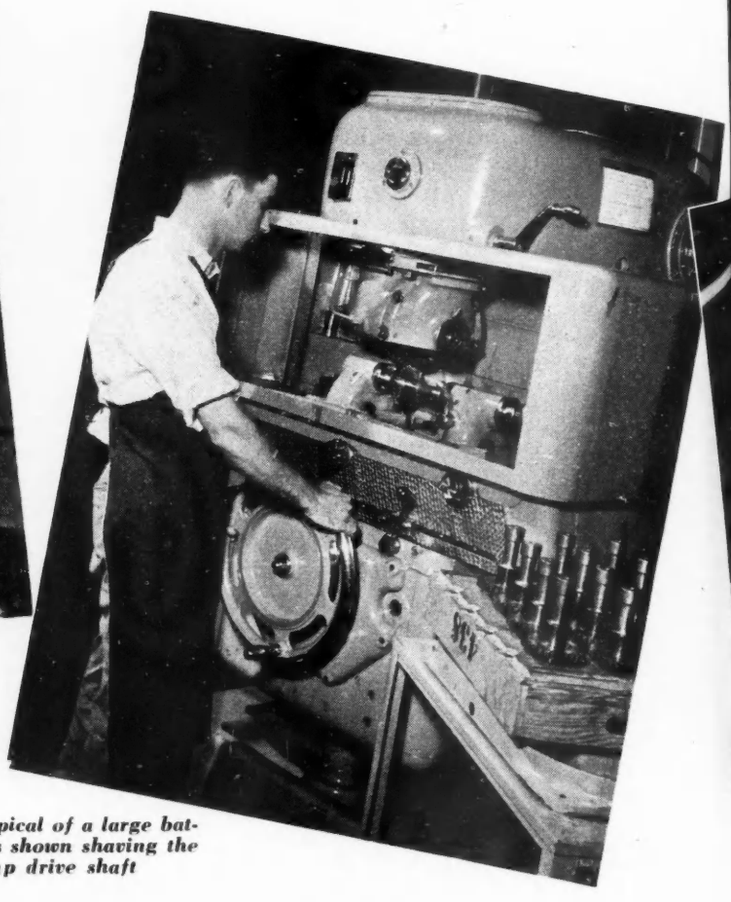
Through the courtesy of a leading manufacturer of V-type aviation engines we have a first-hand picture of the engineering and production considerations that go into the problem of making precision aircraft engine gearing.



(Top) Close up of a J & L precision thread grinder finish-grinding the helical gear of the bevel gear cluster



This is the American Wheelabrator installed in the heat treating department, employed for shot-blasting all heat treated gears



Red Ring gear shaver, typical of a large battery of these machines, is shown shaving the generator and pump drive shaft

Gear Production

at this engine plant is a thing apart from conventional practice

By Joseph Geschelin

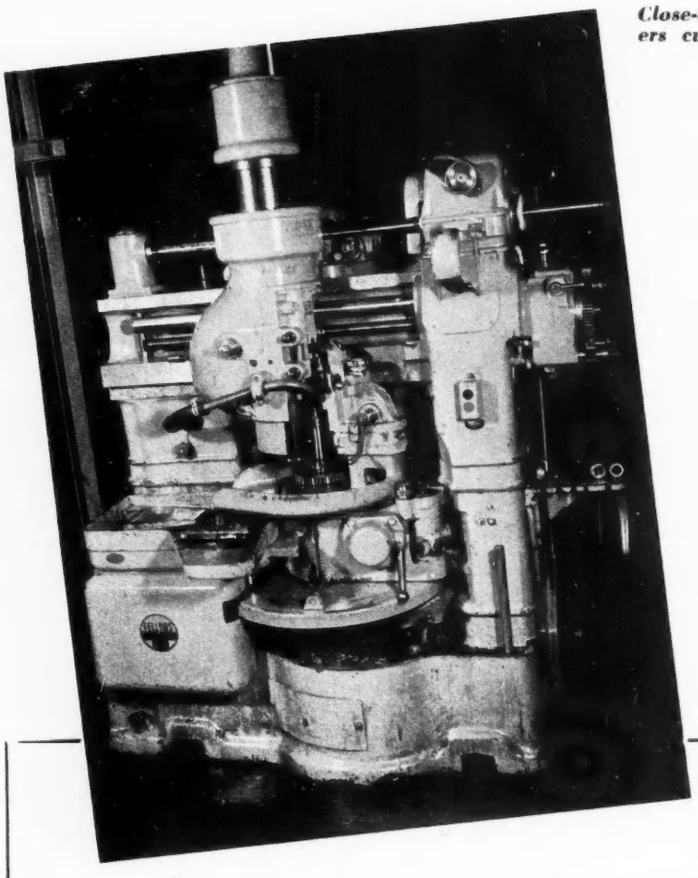
A study of the procedures developed by this company throws light not only on the "why's" of the gear question but on what it takes to handle sub-contracting. The making of aircraft gearing is no ordinary job. It takes background and uncommon skills and production equipment of the finest character.

From an engineering standpoint aircraft gearing is a thing apart from conventional practice. It is subject to rules stemming from the requirements of the engine itself. An ideal airplane engine is one without weight and designers are approaching this ideal as closely as practice permits with mechanism that weighs less than 1 lb. per hp. Since this principle must extend to all components, the gearing must approach size without weight. An examination of any gear in the engine under consideration will show that weight and size both have been brought down to the lowest common denominator.

Consider the two elements—size and weight. Weight must be the very minimum regardless of size. Size is determined entirely by the space permitted for acces-

Looking down on the large horizontal American broaching machine broaching the internal splines in the starter shaft spur gear

One of the Red Ring gear lappers finish-lapping the large gear end of the generator and pump drive shaft



Close-up of one of the large Fellows gear shapers cutting external splines on the vibration damper shaft

sories and by the combination of bearings and drive elements that must be accommodated within the limited space.

These considerations result in uncommonly small gear sizes for uncommonly heavy duty. However, scientific research by the gear experts in recent years has shown unmistakably that the older principles of gear design are quite obsolete. The reason why gears have been large—all out of proportion to their loading—is that the older methods of fabrication have permitted large errors in gear alignment, errors in gear teeth form, errors in the preciseness of tooth bearing areas. However, when the proper procedures and controls and equipment are employed, the aircraft industry has demonstrated that these relatively small gears made as precisely as modern meth-

Factory Routing of Rear Shaft.

OPERATION AND EQUIPMENT

Materials **INSPECTION**
Bench

Laboratory **TEST**
Laboratory

Cycle **ANNEAL**
Hagen furnace

SHOT BLAST
Pangborn shot blast

GRIND spot—10 per cent
Bench grinder

Brinnel **TEST**
Brinnel tester

CHUCK on O.D. of large gear, **FACE** large gear, **TURN** long hub, **RECHUCK, FACE** small gear, **FACE** large gear
No. 5 Warner & Swasey turret lathe

CHUCK on stem end, **FACE** small gear, **FACE** gear rim, **TURN,** finish bore, finish face web, finish turn, center **DRILL**
No. 4 Warner & Swasey turret lathe

CHUCK on O.D. of large gear against face of gear rim, stem end out, **FACE** end, center **DRILL,** turn, finish **TURN,** face, **FACE** side of gear teeth and web down
No. 4 Warner & Swasey turret lathe

Green **GRIND** O.D. of small gear
6x18 Cincinnati cylindrical grinder

Bump **GRIND,** bump straight
6x18 Cincinnati cylindrical grinder

POLISH web and all finished surfaces
Polishing lathe

WASH
Detrex degreaser

INSPECT

HOB large gear teeth
Cleveland gear hobber

Involute **CHECK** 5 per cent
Illinois involute checker

CHECK runout 10 per cent, **INSPECT** check all dimensions 100 per cent
Red liner—Fellows

MASK OFF, copper plate from large gear teeth
Bench

Copper **PLATE**
Plating equipment

REMOVE MASK
Bench

INSPECT
Bench

CARBURIZE
25x36 Homo carburizing furnace

COOL in pit
Controlled cooling pit

ANNEAL
25x36 Homo carburizing furnace

CLEAN off carbon—wire brush
Buffing jack

Rockwell **TEST** 100 per cent
Rockwell tester

LAP centers
Ex-Cell-O center lapping machine

STRAIGHTEN to true up
No. 0 Springfield straightening press

Semi-finish **GRIND**
6x18 Cincinnati cylindrical grinder

Bump **GRIND**
6x18 Cincinnati cylindrical grinder

Finish **SHAPE** teeth on small gear (locate between centers)
7125-A Fellows gear shaper

BURR small gear teeth
Bench

WASH
Detrex degreaser

INSPECT
Bench

Second **CARBURIZE**
25x36 Homo carburizing furnace

COOL in pit
Controlled cooling pit

ANNEAL
25x36 Homo carburizing furnace

CLEAN off carbon—wire brush
Bench

Rockwell TEST 100 per cent

LOCATE in Garrison chuck, finish **FACE** end of hub, center **DRILL** end, drill and **REAM, COUNTERSINK,** finish **TURN, CHAMFER** spline, **BREAK** sharp edges
No. 1F Foster Fastermatic lathe

ods permit, will carry safely the enormous loads imposed on them. And will do their job unfailingly.

Due to the complexity of form of many of these gears, the fabrication process encompasses practically every type of gear cutting and gear finishing equipment known to the art. More recently the gear department has turned to gear shaving—a method made popular in passenger car practice in recent years—as a preferred method of gear finishing for many types of gears used in this engine.

At the present time, this company has in production some 22 different spur gears; 16 different bevel gears; and 23 large spur gears. Out of these we have selected four examples to illustrate the variety of form and the variety of process typical of the activity in the gear department. Consider the generator and pump drive shaft, rear (Fig. 1). Here is a relatively long, slender blank with

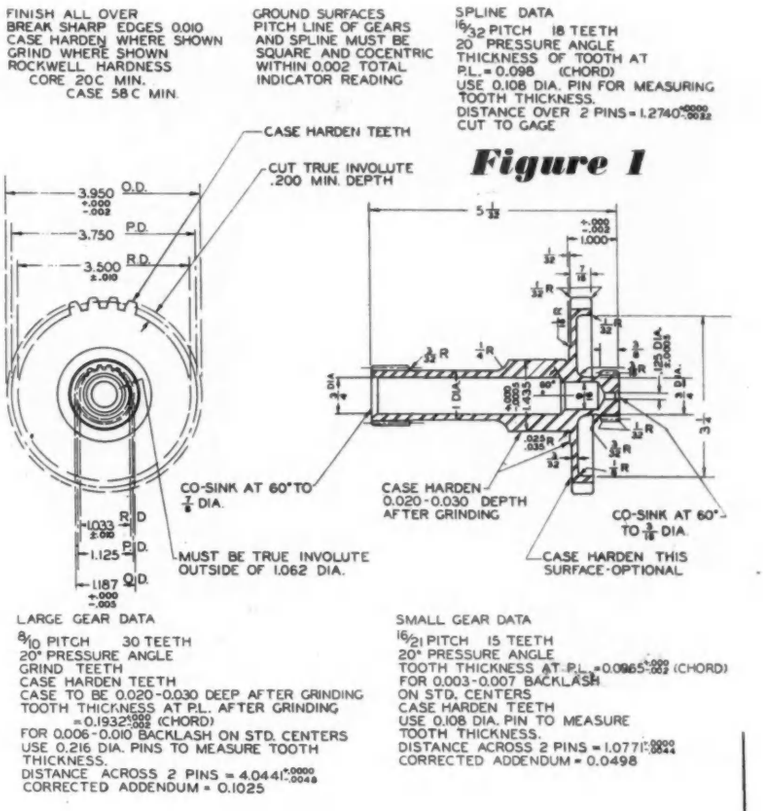

FINISH ALL OVER
BREAK SHARP EDGES 0.010
CASE HARDEN WHERE SHOWN
GRIND WHERE SHOWN
ROCKWELL HARDNESS
CORE 20C MIN.
CASE 58C MIN.
GROUND SURFACES
PITCH LINE OF GEARS AND SPLINE MUST BE SQUARE AND COCENTRIC WITHIN 0.002 TOTAL INDICATOR READING
SPLINE DATA
16/32 PITCH 18 TEETH
20° PRESSURE ANGLE
THICKNESS OF TOOTH AT P.L. = 0.098 (CHORD)
USE 0.108 DIA. PIN FOR MEASURING TOOTH THICKNESS.
DISTANCE OVER 2 PINS = 1.2740
CUT TO GAGE
CASE HARDEN TEETH
CUT TRUE INVOLUTE .200 MIN. DEPTH
3.950 O.D.
3.750 P.D.
3.500 R.D.
1.033 R.D.
1.125 P.D.
1.187 O.D.
CO-SINK AT 60° TO 1/8 DIA.
MUST BE TRUE INVOLUTE OUTSIDE OF 1.062 DIA.
CASE HARDEN 0.020-0.030 DEPTH AFTER GRINDING
CO-SINK AT 60° TO 3/16 DIA.
CASE HARDEN THIS SURFACE-OPTIONAL
LARGE GEAR DATA
8/10 PITCH 30 TEETH
20° PRESSURE ANGLE
GRIND TEETH
CASE HARDEN TEETH
CASE TO BE 0.020-0.030 DEEP AFTER GRINDING
TOOTH THICKNESS AT P.L. AFTER GRINDING = 0.1932 (CHORD)
FOR 0.006-0.010 BACKLASH ON STD. CENTERS
USE 0.216 DIA. PINS TO MEASURE TOOTH THICKNESS.
DISTANCE ACROSS 2 PINS = 4.0441
CORRECTED ADDENDUM = 0.1025
SMALL GEAR DATA
16/21 PITCH 15 TEETH
20° PRESSURE ANGLE
TOOTH THICKNESS AT P.L. = 0.0965 (CHORD)
FOR 0.003-0.007 BACKLASH ON STD. CENTERS
CASE HARDEN TEETH
USE 0.108 DIA. PIN TO MEASURE TOOTH THICKNESS.
DISTANCE ACROSS 2 PINS = 1.0771
CORRECTED ADDENDUM = 0.0498

Figure 1

Generator and Pump Drive

OPERATION AND EQUIPMENT

CHUCK in collet, **FACE** small gear
11 in. LeBlond production lathe

BURR small gear teeth
Bench

CHUCK on P.D. of small gear, **LOCATE** from countersink in stem end and **FACE** of thrust shoulder, **COUNTERSINK, DRILL, REAM**
No. 4 Warner & Swasey turret lathe

LAP both centers and **CHECK** for runout of small gear
Ex-Cell-O center lapping machine

GRIND on centers
6x18 Cincinnati plain cylindrical grinder

Finish **HOB** gear teeth
Cleveland gear hobber

FORM 0.010 radius on edges of gear teeth
Cross chamfering machine

SHAVE gear teeth
Red Ring gear shaver

CHECK involute 10 per cent
Illinois involute checker

CHECK runout 10 per cent
Red liner—Fellows

WASH
Tank

INSPECT—check all dimensions 100 per cent

HARDEN
Lindberg Hydrizer furnace

QUENCH
Gleason quenching press

Vapor **DEGREASE**
Detrex degreaser

TEMPER
20x36 Homo draw furnace

SHOT BLAST
Pangborn shot blast

Rockwell **TEST** 100 per cent
Bench

DEPLATE
Plating equipment

ETCH serial number
Bench

POLISH hole to remove scale, **POLISH** all unground surfaces if needed
Shaver Ideal lathe

LAP centers in both ends for concentricity
Ex-Cell-O center lapping machine

REDLINE small gear 100 per cent
Red Line gear checker—Fellows

INSPECT for concentricity of small gear with centers 100 per cent
Bench

Finish **GRIND** O.D. of large gear
6x18 Cincinnati cylindrical grinder

Finish **GRIND** spline diameter
6x18 Cincinnati cylindrical grinder

Semi-finish **GRIND, BUMP** straight side
6x18 Cincinnati cylindrical grinder

Finish **GRIND, CHAMFER**
No. 7 Grand Rapids grinder

Finish **GRIND** thrust shoulder
No. 7 Grand Rapids Universal grinder

GRIND face of small gear, **GRIND** gear rim face on small gear side
No. 22 Heald rotary surface grinder

Finish **CUT** spline to gage
7125-A Fellows gear shaper

Finish **GRIND** to size
6x18 Cincinnati cylindrical grinder

BUFF spline and teeth on both gears
Marschke Buffer

LAP large gear teeth
Red Ring lapper

WASH
Detrex degreaser

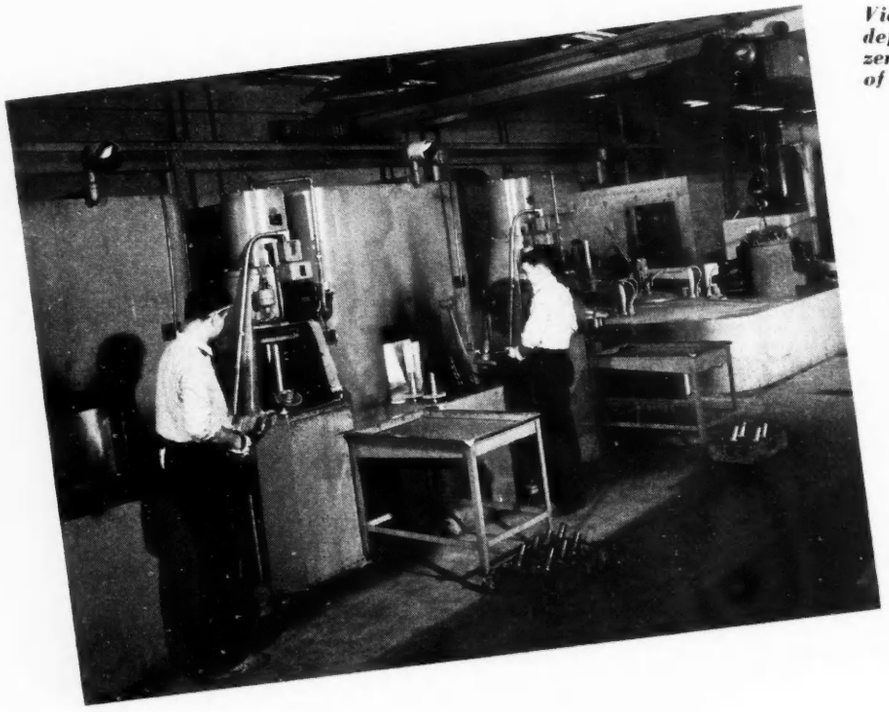
Speed large gear 100 per cent
Red Ring speeder

CHECK involute
Illinois involute checker

CHECK runout of both gears
Red Liner gear checker

INSPECT Visual 100 per cent

INSPECT final
Magnaflux
Etch part number
Rockwell test



View along one wall of the heat treating department, showing Lindberg Hydrizers, Homo drawing furnace, and several of the Gleason gear quenching machines

a large and a small spur gear at one end, a spline at the opposite end. It is made of AMS 6290-1 or 6250-1 gear steel. The details of the fabrication process will be found on the routing. The large gear is rough-hobbed on a Cleveland hobbing machine, case-carburized and annealed. The small gear then is cut on a 7125-A Fellows gear shaper. Next follows another case-carburizing operation and annealing. The large gear is finish-hobbed, then shaved on a Red Ring gear finisher. The work is hardened in a Lindberg Hydrizer furnace, and drawn. The spline end now is cut on a Fellows gear shaper. And finally, the large gear teeth are lapped, when necessary, on a Red Ring lapping machine.

Another example of extreme complexity is found in the accessory housing camshaft drive gear (Fig. 2), which is made of AMS 6250-1 gear steel. This is an even more slender blank with a large spur gear at onee nd, a helical gear in the center, and a bevel gear at the other end. The bevel gear is cut in two operations on two-tool Gleason generators; the spur gear is hobbed in one operation; while the helical gear is semi-finish cut on a Milwaukee milling machine. After heat treatment, the large gear is ground on a Pratt & Whitney or Detroit Gear grinder while the helical gear is ground on a Jones & Lamson precision thread grinder.

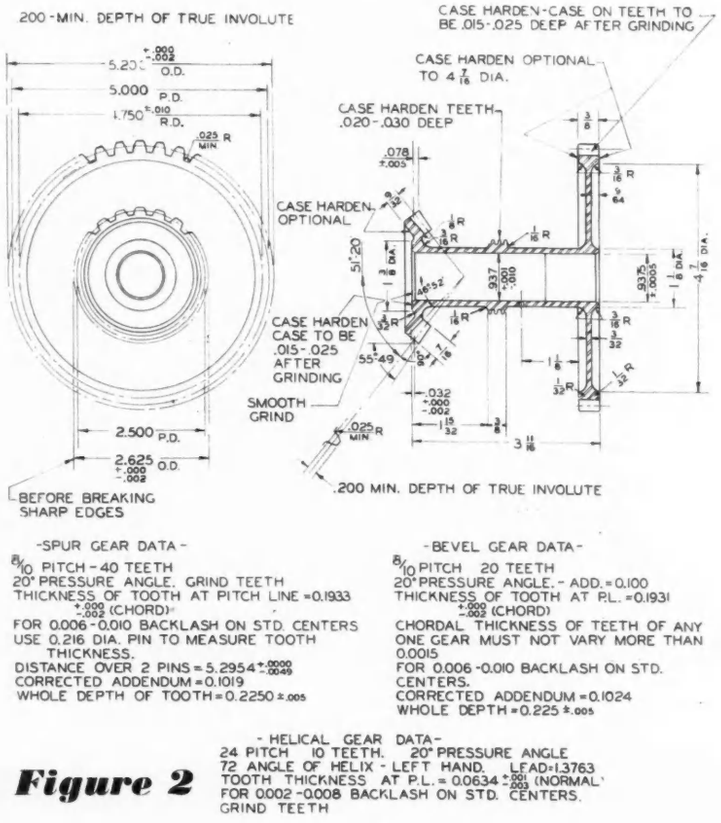

.200-MIN. DEPTH OF TRUE INVOLUTE
CASE HARDEN-CASE ON TEETH TO BE .015-.025 DEEP AFTER GRINDING
CASE HARDEN OPTIONAL TO 4 7/16 DIA.
CASE HARDEN TEETH .020-.030 DEEP
CASE HARDEN OPTIONAL
CASE HARDEN CASE TO BE .015-.025 AFTER GRINDING
SMOOTH GRIND
5.000 P.D.
2.500 P.D.
2.625 O.D.
.200 MIN. DEPTH OF TRUE INVOLUTE
BEFORE BREAKING SHARP EDGES
-SPUR GEAR DATA-
8/10 PITCH - 40 TEETH
20° PRESSURE ANGLE. GRIND TEETH
THICKNESS OF TOOTH AT PITCH LINE = 0.1933 (CHORD)
FOR 0.006 - 0.010 BACKLASH ON STD. CENTERS
USE 0.216 DIA. PIN TO MEASURE TOOTH THICKNESS.
DISTANCE OVER 2 PINS = 5.2954
CORRECTED ADDENDUM = 0.1019
WHOLE DEPTH OF TOOTH = 0.2250
-BEVEL GEAR DATA-
8/10 PITCH 20 TEETH
20° PRESSURE ANGLE. - ADD. = 0.100
THICKNESS OF TOOTH AT P.L. = 0.1931 (CHORD)
CHORDAL THICKNESS OF TEETH OF ANY ONE GEAR MUST NOT VARY MORE THAN 0.0015
FOR 0.006 - 0.010 BACKLASH ON STD. CENTERS.
CORRECTED ADDENDUM = 0.1024
WHOLE DEPTH = 0.225
- HELICAL GEAR DATA -
24 PITCH 10 TEETH. 20° PRESSURE ANGLE
72 ANGLE OF HELIX - LEFT HAND. LEAD = 1.3763
TOOTH THICKNESS AT P.L. = 0.0634 (NORMAL)
FOR 0.002 - 0.008 BACKLASH ON STD. CENTERS.
GRIND TEETH

Figure 2

Typical of the large spur gears is the starter shaft gear (Fig. 3), which is made of AMS 6250 gear steel. A number of gears of this type are being shaved after the second hobbing operation, eliminating the grinding operation employed originally. An interesting feature of this gear is the long spline through the hub, produced on Fellows gear shapers.

The last example is the vibration damper outer shaft (Fig. 4) which is made of AMS 6250 gear steel. This has a 6.000 in. P.D. spur gear, a 5.250 P.D. internal spline at the extreme end, an external spline at the center, and a small internal spline at the opposite end. The spur gear is hobbed, then finish-ground on a Pratt & Whitney gear grinder; all of the splines are cut on Fellows gear shapers.

Examination of these drawings shows that apart from the extremely close tolerances which must be maintained on all dimensions and on gear teeth and splines, the delicacy of the process is further accentuated by the necessity for true alignment and concentricity of the P.D. of gear teeth and splines. It is this requirement, in particular, that makes production gear procedure so intricate and demands such painstaking care at every stage of the process.

In appraising this company's gear practice,

one important fact stands out—the fact that all tolerances and specifications are established by the engineering department, based upon the service requirements of each individual gear, a resultant both of engineering analysis and flight data. Unlike the situation in the passenger car field, the established specifications are not subject to modification by the production department. On the contrary, the production department must devise the means and the procedures required to produce gears exactly as specified. That is another phase of aircraft gear manufacture that sets it apart from the conventional.

It also explains why new procedures such as gear shaving, for example, needs must be adopted slowly and only after due approval both by the engineering department and the Air Corps.

So far as gear tolerances are concerned, the engineering department issues a chart to the production department, listing the following kind of information:

Involute—desired and maximum tolerances.

Tooth spacing — tooth to tooth and total range.

Degree of roll—maximum, and from O.D. to P.D.

These data are repeated for the Drive side and the Coast side of the tooth for each gear.

Quality control is the basic ingredient. In the main it extends to the following elements:

Gear steel specifications.

Forging specifications.

Gear cutting.

Heat treatment.

Die-quenching.

Inspection.

Quality control begins with the bench inspection of incoming rough forgings, according to the following outline:

a. Inspect identification marks.

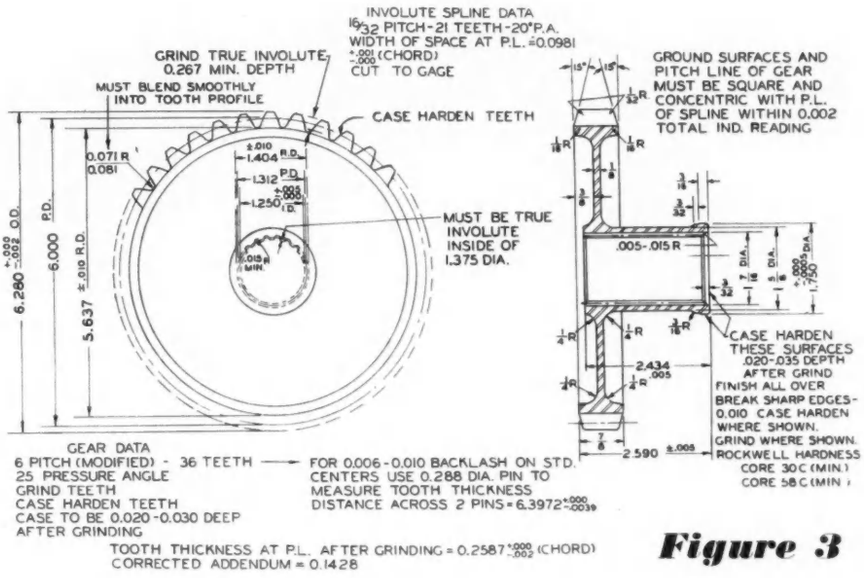
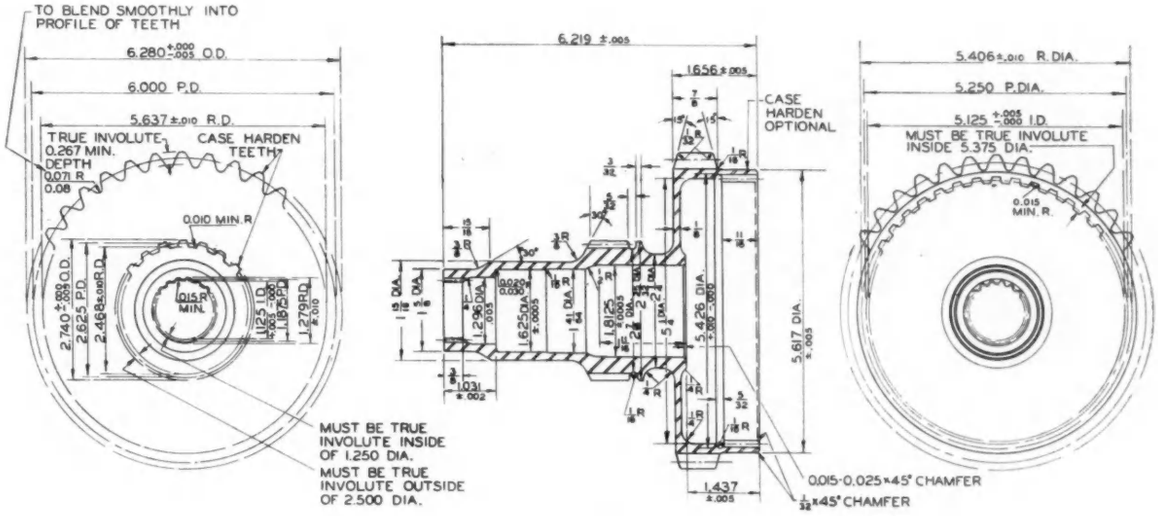


Figure 3



-6.000 P.D. GEAR DATA-
6 PITCH (MODIFIED) -36 TEETH
25° PRESSURE ANGLE
GRIND TEETH
CASE HARDEN TEETH
CASE TO BE 0.020-0.030 DEEP AFTER GRINDING
TOOTH THICKNESS AT PITCH LINE AFTER GRINDING = 0.2587 (CHORDAL)
FOR 0.006-0.010 BACKLASH ON STD CENTERS
USE 0.288 DIA. PIN TO MEASURE TOOTH THICKNESS
DISTANCE ACROSS TWO PINS = 6.3972
CORRECTED ADDENDUM = 0.1428

- 1.1875 P.D. INTERNAL SPLINE DATA -
16/32 PITCH - 19 TEETH
20° PRESSURE ANGLE
WIDTH OF TOOTH SPACE AT P.L. = 0.0981 (CHORDAL)
CUT TO GAGE

- 2.625 P.D. EXTERNAL SPLINE DATA -
8/16 PITCH - 21 TEETH
20° PRESSURE° ANGLE
CASE HARDEN TEETH 0.030-0.040 DEEP
THICKNESS OF TOOTH AT PITCH LINE = 0.1957 (CHORDAL)
USE 0.216 DIA. PIN TO MEASURE TOOTH THICKNESS
DISTANCE ACROSS TWO PINS = 2.9153
(REF. ONLY)
CUT TO GAGE +C
CORRECTED ADDENDUM = 0.0611

5.250 P.D. INTERNAL SPLINE DATA -
8/16 PITCH - 42 TEETH
20° PRESSURE ANGLE
WIDTH OF SPACE AT PITCH LINE = 0.1963 (CHORDAL)
CUT TO GAGE

FINISH ALL OVER
BREAK SHARP EDGES 0.010
GRIND WHERE SHOWN
ROCKWELL HARDNESS - CORE 27C MIN
CASE 58C MIN
PITCH LINES OF SPLINES AND GEARS
MUST BE CONCENTRIC WITH CENTER
LINE ESTABLISHED BY 1.625 DIA. AND
1.8125 DIA. BORES WITHIN 0.002 TOTAL
INDICATOR READING

Figure 4

b. Select one forging from each shipment, mark it and send to materials laboratory.

c. Keep all heats in each shipment separate until released by lab.

d. The inspection department is responsible for proper disposition of materials after receiving notice of acceptance or rejection by the materials lab.

The next step in the actual laboratory testing of samples according to the outline given below:

a. Assign a test number to and mark each specimen received.

b. Determine the chemical composition of specimen S.M. 1, 2, 3, 4, 5, 6, and 7.

c. Etch and examine quality and flow of lines S.M. 100.

d. Test hardenability S.M. 125.

e. Determine grain size S.M. 167.

f. Record all test.

g. Report acceptance or rejection to material control and inspection department.

In the production departments, quality control is an extensive operation reaching every stage of the process with suitable checking equipment and instrumentation. For example, each new machine set-up is checked initially and machine performance further checked by a 10 per cent sampling procedure. But before the set-up is made, the hobs, cutters, etc., all are checked to assure conformity to tool specifications.

In addition to the inspection at each stage, there is a final inspection which checks each gear 100 per cent. Gear teeth are run through the Fellows Red Liner 100 per cent; and all gears are subjected to a 100

(*Turn to page* 62, *please*)

Factory Routing of Accessories Housing, Camshaft Drive

OPERATION AND EQUIPMENT

Receiving **INSPECTION** for rough blank, dimensional and visual
Bench

LOCATE on O.D. of spur gear, broach hole
H-15-60 American horizontal broach

LOCATE on broached hole, grind O.D. of spur gear
10x36 Norton cylindrical grinder

CHUCK on O.D. of spur gear, **FACE** outside rim and hub of spur gear to 3.728—0.003 from thrust end. Finish **FORM** spur gear web on the outside 0.159—0.005 depth from rim. Hold 3/16 R in corners
No. 5 Warner & Swasey turret lathe

CHUCK on O.D. of spur gear, **FACE** thrust shoulder, **FACE** bevel gear end, **TURN** O.D. of bevel gear, finish **FORM** back face of bevel gear, **FORM** contact face, finish **FORM** end of bevel gear, **FACE** inside rim of spur gear, **FORM** inside web of spur gear
No. 5 Gisholt lathe

CHUCK on O.D. of bevel gear, finish **TURN** stem between bevel gear and helical gear, finish **TURN** O.D. of helical gear, finish **TURN** stem between helical and spur gear, finish **FORM** under face of bevel gear
No. 5 Gisholt lathe

GRIND inside of spur gear to clean up, **GRIND** outside rim and hub of spur gear
6x18 Cincinnati cylindrical grinder

COUNTERSINK thrust end
No. 121 Baker single spindle drill press

COUNTERSINK spur gear end
No. 121 Baker single spindle drill press

BURR—COUNTERSINK if necessary
Bench

POLISH
Ideal speed lathe

WASH
Detrex washer

INSPECT visually and dimensionally
Bench

MASK O.D. helical gear with rubber tape, **MASK** O.D. spur gear with rubber tape
Bench

Copper **PLATE**
Plating tank

REMOVE MASKING
Bench

INSPECT
Bench

WASH
Tank

Finish **GRIND** contact face of bevel gear
No. 7 Grand Rapids Universal grinder

GRIND copper from both sides of spur gear
No. 1 Brown & Sharpe Universal grinder

INSPECT contact face in relation to thrust face
Bench

Rough **CUT** bevel gear teeth
12 in. two-tool Gleason generator

Finish **CUT** bevel gear teeth
12 in. two-tool Gleason generator

BREAK all corners
Bench

WASH
Spray washer

INSPECT and **RUN IN** soft
No. 13 Gleason tester and run-in machine

HOB spur gear leaving 0.004 to 0.005 in. per side
No. 130 Cleveland hobbing machine

SEMI-FINISH cut helical gear
No. 2 Milwaukee universal milling machine

BURR helical and spur gear
Bench

WASH
Spray washer

INSPECT spur gear and helical gear
Bench

CARBURIZE
25x36 Homo carburizing furnace

COOL in pit
Cooling pit

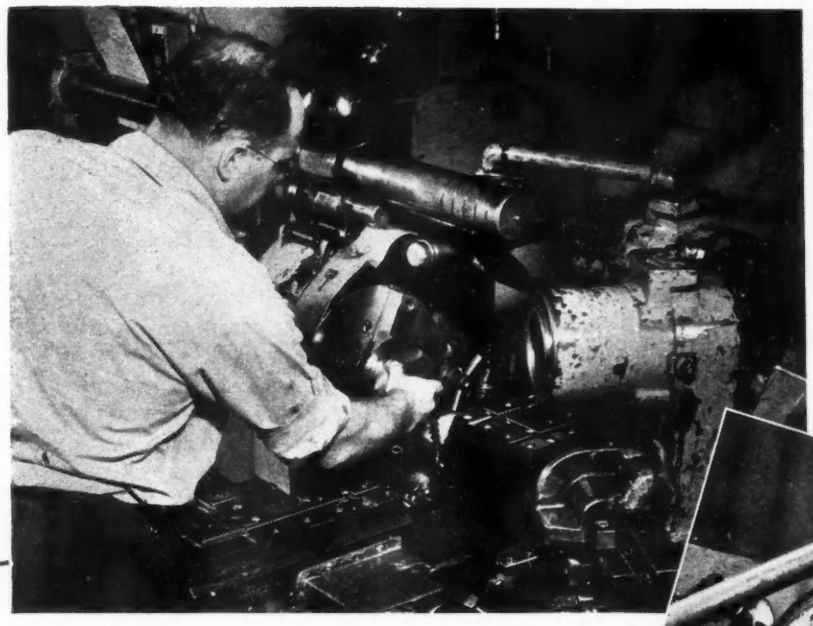
ANNEAL
25x36 Homo carburizing furnace

CLEAN off carbon
Bench

CLEAN centers both ends
No. 74 Ex-Cell-O center lapping machine

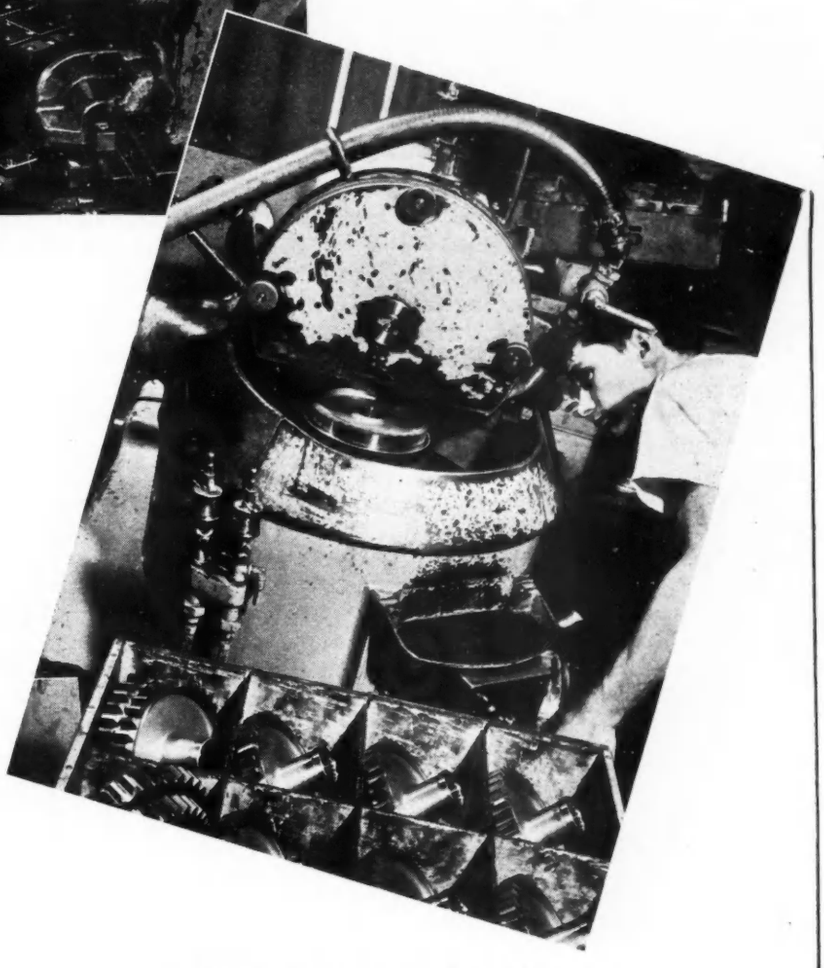
(**LOCATE** on tapered arbor) Green grind O.D. spur
10x36 Norton cylindrical grinder

Core **DRILL** hole to 7/1 in. dia. thru, rough and finish bore
No. 5 Warner & Swasey turret lathe



Here is the turning of the starter shaft spur gear blank on the Foster Fastermatic

Heald rotary grinder used for finish-grinding the rim face and hub ends of starter shaft spur gears



and Bevel Gear

OPERATION AND EQUIPMENT

DRILL 3/32 in. hole thru one wall
No. 999 Delta single-spindle drill press

BURR hole
Bench

WASH
Spray washer

INSPECTION—hole and drilled hole
Bench

HEAT TREAT
Lindberg Hydrizer

HARDEN and **QUENCH**
Gleason press

Vapor **DEGREASE**

TEMPER
20x26 Homo draw furnace

SHOT BLAST
Pangborn shot blast machine

Rockwell **TEST**—100 per cent

DEPLATE
Plating tank

INSPECTION—deplating

POLISH bevel and helical lightly
Marschke buffer

Clean centers
No. 74 Ex-Cell-O center lapping machine

GRIND O.D. spur gear
10x36 Norton Cylindrical grinder

GRIND hole
No. 72-A-3 Sizematic Heald internal grinder

Finish **GRIND** thrust end to correct back lash
No. 72-A-3 Sizematic internal grinder

GRIND O.D. of helical gear to size
10x36 Norton cylindrical grinder

GRIND outside face of rim and hub end
No. 22 Heald rotary surface grinder

GRIND inside face of rim 3/8 in. wide, blend 1/32 in. radius with stone inside of rim
6x18 plain cylindrical grinder

Finish **GRIND** spur gear teeth
Detroit gear grinder

Finish **GRIND** helical gear to size
Jones & Lamson thread grinder

BURR and **POLISH** gear teeth, **BREAK** corners
Bench

INSPECT—spur gear and etch
Illinois involute checker

BUFF gear
Marschke buffer

INSPECT and run bevel gear in hard
No. 13 Gleason run-in machine

WASH and dip in soluble oil
Detrex degreaser

INSPECTION (final)
Bench
Rockwell tester
Magnaflux equipment

INSPECTION (Army)
Bench

The Tenth Annual Meeting of

The Institute of the Aeronautical Sciences

By James R. Custer

COMING FROM the various industrial centers of the country, hundreds of engineers and executives of the aircraft and allied industries joined with representatives of the Government, Army, Navy and scientific institutions during the last week of January in New York City to study technical and manufacturing problems confronting them. The occasion was the Tenth Annual Meeting of the Institute of the Aeronautical Sciences, which sponsored a series of technical sessions at the Pupin Physics Laboratories, Columbia University. Many of the technical papers had a restricted status due to their direct bearing on military developments.

During the annual honors night dinner at the Waldorf-Astoria Hotel, which opened the meeting, Hall L. Hibbard, vice-president and chief engineer of the Lockheed Aircraft Corp., was inducted as president of the Institute for 1942, succeeding Frank W. Caldwell, director of research, United Aircraft Corp. The other officers elected for 1942 are: Vice-Presidents—C. S. Jones, president of Casey Jones School of Aeronautics; Grover Loening, consulting aeronautical engineer; J. G. Vincent, vice-president of engineering, Packard Motor Car Co.; and Thomas A. Morgan, president, Sperry Corp.; Treasurer—Earl D. Osborn, president, Edo Aircraft Corp.; Executive Vice-President—Lester D. Gardner; Secretary—C. E. Sinclair.

Fellowships in the Institute were conferred upon George W. Brady, chief engineer, Curtiss Propeller Division of Curtiss-Wright Corp.; John W. Crowley, Jr., senior aeronautical engineer, N.A.C.A. Langley Memorial Aeronautical Laboratory; Ralph S. Damon, president, Republic Aviation Corp.; William K. Ebel, vice-president and chief engineer, Glenn L. Martin Co.; Michael E. Gluhareff, chief of design and aerodynamics, Vought-Sikorsky of United Aircraft Corp.; Ronald M. Hazen, vice-president and chief engineer, Allison Division of General Motors; Capt. F. W. Pennoyer, Jr., Bureau of Aeronautics, Navy Department; Harry A. Sutton, aeronautical engineer, Consolidated Aircraft Corp.; Capt. W. W. Webster, manager, Naval Aircraft Factory, Philadelphia; Robert J. Woods, chief engineer, Bell Aircraft Corp.

Honorary memberships were conferred upon the following Government officials: Robert A. Lovett, Assistant Secretary of War for Air; Artemus L. Gates, Assistant Secretary of Navy for Air; Robert H. Hinckley, Assistant Secretary of Commerce for Air; L. Welch Pogue, chairman, Civil Aeronautics Board; and Merrill C. Meigs, chief, aircraft branch, War Production Board.

The Daniel Guggenheim Medal, the annual award for notable achievement in aeronautics, was presented to Juan Terry Trippe, president of Pan American Airways, in recognition of his contribution to the development and successful operation of oceanic air transport. This presentation was made by Brig. Gen. Donald H. Connolly, Military Director of Civil Aviation, Army Air Forces. Other awards were made as follows:

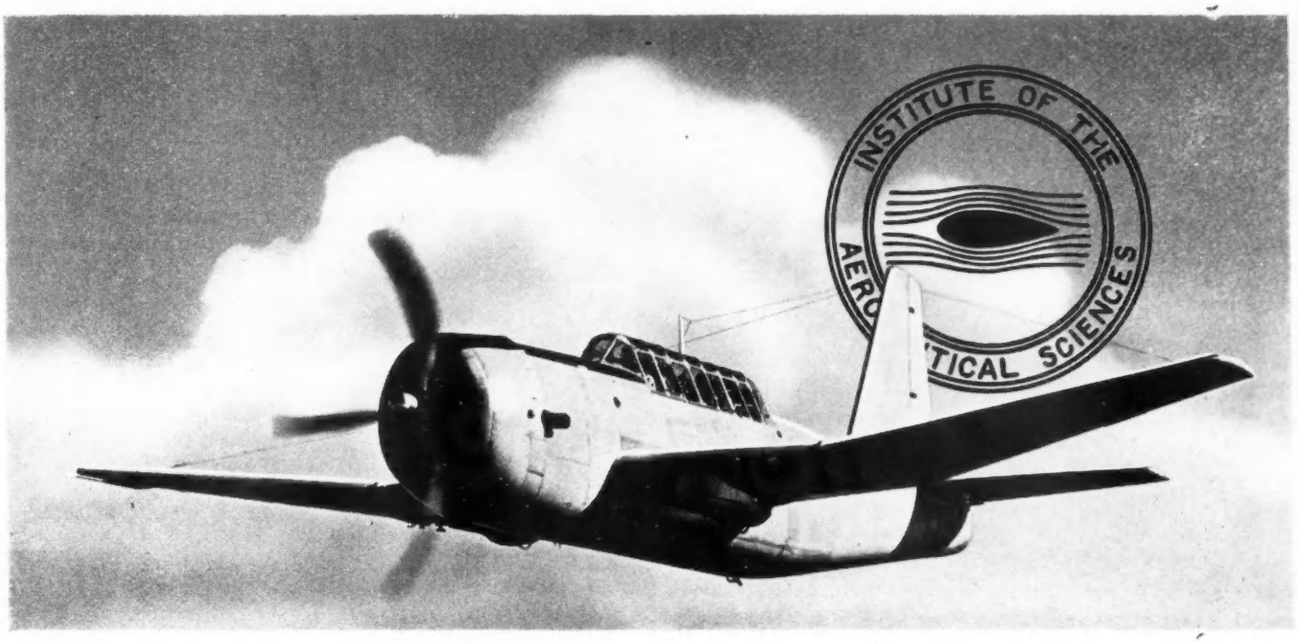
Sylvanus Albert Reed Award—to Dr. Theodore von Karman, director of the Daniel Guggenheim Graduate School of Aeronautics at the California Institute of Technology, for the development of a satisfactory theory of the influence of curvature on the buckling characteristics of aircraft structures.

Octave Chanute Award—to Melvin N. Gough, senior test pilot at the N.A.C.A. Langley Memorial Aeronautical Laboratory, for his outstanding contributions to fundamental research in aeronautics as conducted on airplanes in actual flight.

Lawrence Sperry Award—to Ernest G. Stout, engineer in charge of aerodynamics and flight testing for Consolidated Aircraft Corp., for his contribution to the experimental determination of the hydrodynamic stability of model flying boats and seaplanes.

John Jeffries Award—to Maj. Harry G. Armstrong, in charge of the Air Corps School of Aviation Medicine, Randolph Field, Tex., for his basic studies on the physiological and psychological effects of flight at high altitude and the description of a number of clinical entities involved, establishment of the Army Aero Medical Research Laboratory and contributions to the literature of aviation medicine.

Robert M. Losey Award—to Dr. Horace R. Byers, in charge of the training of meteorological officers for the Army and Navy at the Meteorological Institute of the University of Chicago, for his research in air mass



analysis and its applications in synoptic and aeronautical meteorology.

Morning, afternoon and evening sessions were held during the three days, the first of which was given over to papers on airplane structures, powerplants, radio and instruments, and design problems. At the structures session F. R. Shanley, Lockheed engineer, analyzed sheet metal forming problems by the use of stress-strain diagram and simple elastic theories. Combined tensile stresses were shown to be undesirable in forming and dangerous under impact loading. Combined tension and compression at right angles, causing shear strains, are considered best for forming. He outlined analytical methods for determining minimum bend radius, springback, wrinkling of flanges, limits for drawing, and other operations.

In discussing stress analysis of rings for monocoque fuselages, N. J. Hoff of the Polytechnic Institute of Brooklyn made suggestions for increasing the accuracy in calculating the unknown quantities in closed rings of arbitrary shape and graphical methods were introduced for the determination of the moment distribution in the "simple" system caused by the shear flow transmitted by sheet covering. A. J. Williamson and J. P. Dods, Summerill Tubing Co., reviewed present-day welding methods as applied to aircraft steels. In the paper, "Bending and Torsional Design Charts for Chrome-Molybdenum Tubing," V. C. Trimarchi of the Rensselaer Polytechnic Institute simplified the general case of combined bending and torsion by use of the "equivalent" moments method. In order to determine the possible weight saving and general suitability of magnesium alloys for aircraft construction, the Bureau of Aeronautics and the Dow Chemical Co. have cooperated in the design, construction and static test of a wing directly comparable to an aluminum alloy structure. Description of the design and the results of preliminary static tests were given by Emerson W. Conlon, of the University of Michigan, and John C. Mathes, Dow Chemical Co. The use of resin-bonded wood laminates for shell type aircraft structures was discussed by Alfred A. Glassner of the Duramold Aircraft Corp.

At the design session E. S. Jenkins and A. F. Donovan, engineers at the Curtiss-Wright Buffalo plant, gave the paper, "Tricycle Landing Gear Design," in which was discussed the general geometric arrangement involving the determination of wheelbase, tread, and center of gravity location. It was shown that the nose wheel should be located as far forward of the center of gravity as possible, and that the fore and aft location of the rear wheels is limited to a narrow range by conditions of balance and longitudinal stability. E. Burke Wilford, Pennsylvania Aircraft Syndicate, in his paper compared the physical properties of beryllium alloys with those of aluminum, magnesium and steel. Possible uses for engine forgings and other aircraft parts also were considered. How American Airlines accomplishes vibration and noise reduction by balancing the propellers after they are mounted on the engines of its transport planes was described by R. D. Speas and J. C. Luttrell.

Sessions of the second day were devoted to materials, rotating wing aircraft and physiologic problems. With limited supplied of metals available, plastics and plywood received considerable attention. George W. DeBell, of the Glenn L. Martin Co., emphasized the importance of plastics in aircraft construction. By using these materials in all aircraft applications in which they are equally suitable, and in which they do not affect the over-all design of the plane, it would be possible to economically save 41 million lb. of aluminum per year, he said.

Aircraft plywoods and their value as a production material for emergency conditions were discussed by Hugh G. Bersie and Edwin R. Clarke, of the Haskelite Corp., who pointed to the ease and promptness with

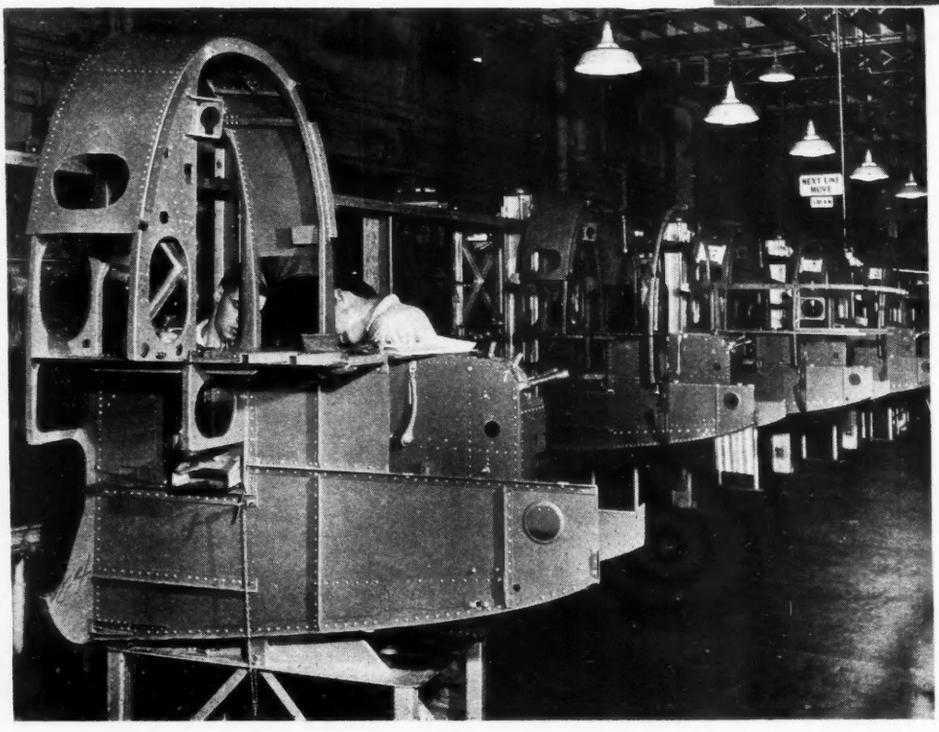
(*Turn to page* 60, *please*)

LATEST of the production innovations of Douglas Aircraft Co., Inc., is the new "vertical" assembly line at its El Segundo, Calif. plant to produce nose sections for A-20B attack-bombers. This plant's assignment to build nose sections is part of the vast plan for distribution of fabrication and subassembly which is being participated in by not only the Douglas plants, but by automobile, railroad car, and other airplane manufacturers. Final assembly of A-20 attack-bombers is located at Douglas' Long Beach plant.

To meet the high output of attack-bombers by the Douglas organization necessitated the development of an assembly line at El Segundo capable of producing the nose units well in advance of Long Beach requirements. These nose units represent on small scale nearly every type of fabrication and assembly contained in a completed airplane. Weighing 300 lb., the nose section has as it components the frame structure, armament, instruments, glass, plumbing, electrical equipment, hydraulic installations, and seats, all integrated into a complex pattern. It requires the utilization of all types of equipment, tools, and skilled labor available at El Segundo plant comparable to the requirements of a completed airplane.

To facilitate the assembly of the units in the various stages of production, it was apparent that they would move down the assembly line in a position comparable to that which they assume when actually installed on the airplanes. It became necessary, therefore, to develop what may literally be called a "vertical" assembly line, which would have the general characteristics of the horizontal track assembly line, and at the same time, would be accessible from all sides as well as top and bottom.

To create such an assembly line, a series of H beams were set in concrete foundations in the floor of the plant, to which were attached rails. Heavy reinforced face plates are mounted on these rails by means of flanged rollers which permit easy movement down the assembly line. The plates are tied to each other



(Above) In developing this "vertical" assembly line, Douglas instituted a new technique for speeding the production of bomber nose sections at its El Segundo plant.

(Left) The A-20 bomber nose looks like this when it starts down the jig-track "vertical" assembly line. Its major structural members are assembled first.

These bomber noses are near completion for the final assembly line. Note how the jig holds each one in a conveniently accessible position at all times.

Douglas "Vertical" Assembly Line

by means of a six-foot tie bar, and the entire line moves in unison. Both sides of the line are utilized for assembly work. For complete assembly the nose is required to make one complete circuit of the line.

An ingenious turntable device on each end of the line makes it possible to bring a nose assembly from one side to the other, without removing it from the plate. As the nose nears the last station of the line, it is removed from the moving face plate and attached to a hinged face plate equipped with counter-balances that swing it into an upright position for the necessary routing and trimming operations. It is then removed and placed in a saddle for painting and camouflage work prior to shipment to the Long Beach plant.

The use of this so-called "vertical" type assembly line has a number of distinct advantages for the assembly of a unit of this kind.

1. It permits the unit to remain in a position which it normally assumes when attached to the airplane.

2. The unit upon which the assembly is being accomplished is completely unobstructed by rails, tracks, etc., and is accessible from all directions except the rear, which is normally closed off by structure.

3. It is at a convenient height from the factory floor for access by a man of an average height.

4. It has sufficient clearance from the floor to avoid obstruction by benches, ladders, etc., and therefore is subject to minimum damage.

Another innovation on this assembly line is the fact that the use of elaborate fixtures and jigs on the production line itself has been eliminated. All subassembly work is accomplished immediately adjacent to the line and the large sub units are built up in the stationary tooling before reaching the line. All holes are coordinated and drilled to full size, therefore reducing "drilling on assembly" to a minimum.

The major subassembly units are held in place on the assembly line by means of a simple tubular support mounted from the face plate to an attaching point well forward in the nose section. By this simple jig the entire structure is held in a rigid position, torsionally and otherwise, while the initial riveting operations are carried out. This permits, therefore, easy access to all parts of the unit even during the initial stages of assembly.

The development of this new assembly line at the El Segundo plant offered an opportunity to the personnel of the plant to become fully versed in adapting the same methods to the production of the dive bombers, which represent the El Segundo plants main output.

This small setup also permits new methods of assembly to be explored that otherwise would be difficult to develop on a completed airplane.

What it Takes

to Make 125,000 Warplanes a Year

By Col. John H. Jouett *

THE President of the United States gave us our orders in his historic message to Congress. They call for 60,000 planes this year and 125,000 in 1943. It has been pointed out that this means 1 warplane every 8 minutes during the next 12 months and 1 every 4 minutes next year. It means that this year we must approximately triple last year's production and then double that output in 1943. It means much more than that.

Here are some of our present problems in meeting the President's program for 60,000 planes this year and 125,000 next. We must find means of increasing factory floor space from the present 50 million to more than 80 million sq. ft. this year and then boost it to more than 180 million sq. ft. for the next year's program. A material increase in factory space will result when the subcontractors start operating new plants now nearing completion, when our companies get into production with the new assembly plants for which the subcontractors in the motor car industry are making parts, and finally, when the motor car manufacturers themselves achieve full production in the plants built for this purpose.

Labor is another item. It must be trained to work in aircraft plants. From about 400,000 at present in our own industry, the entire program demands an increase to more than 700,000 within the next few months and upward of 2 million, including the motor car people, to produce 125,000 planes next year. It means a dollar output jumping from $1½ billions last year to nearly $4 billions this year and nearly $9 billions next year. More of everything is required to make a 4-engine bomber than a 2-engine bomber, a pursuit ship or a trainer. All vary in weight, and the number of man-hours required to build them.

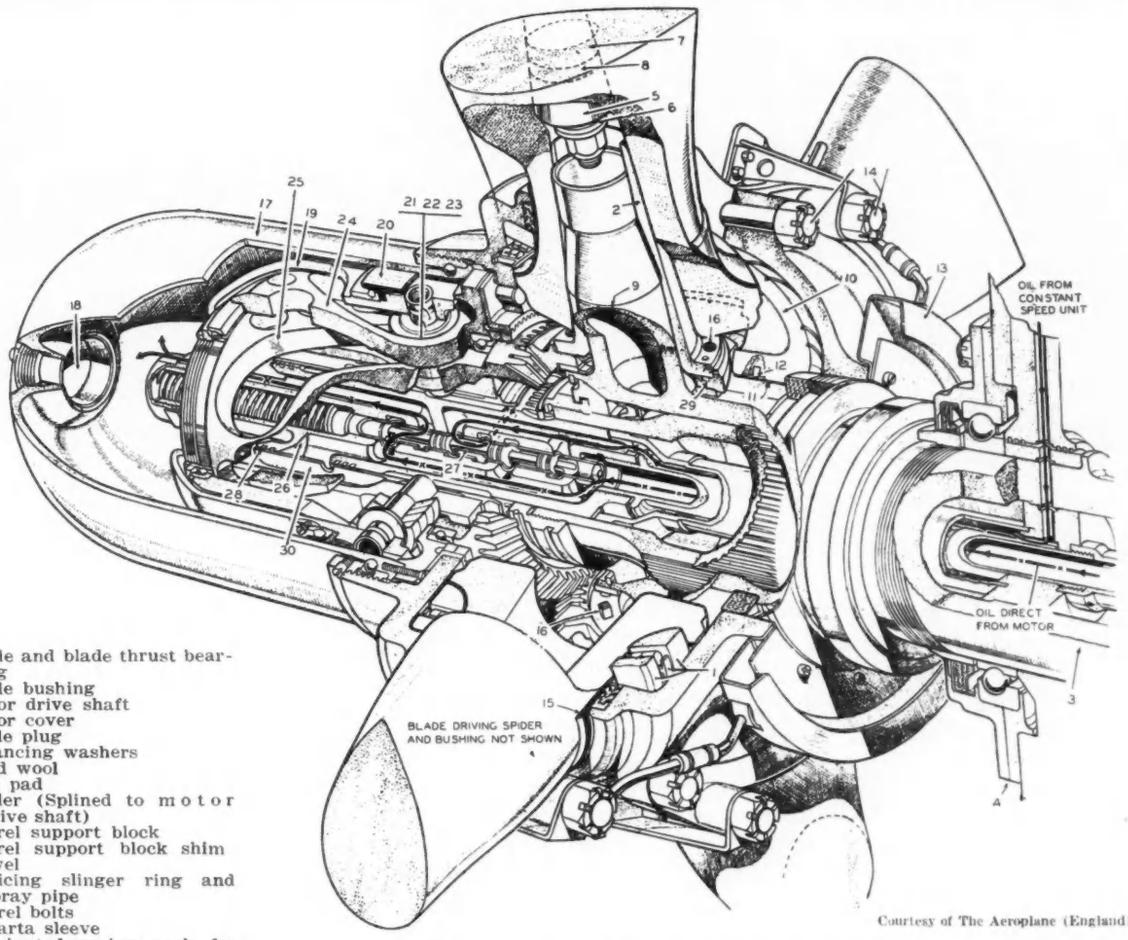
We are under way toward a tenfold increase in our output of 4-engine bombers, by far the best of their type in the world. They are for long range, high altitude offensive warfare.

Taking all types, 185,000 planes in two years means more than three engines per plane average, a total of approximately 555,000 engines. Take the spark plug as one little item alone. It means spark plugs by the millions, possibly 50 million. And those 50 million spark plugs must not be wrong; or the crew and a flying machine worth up to a third of a million dollars will fail in their mission and be on the casualty list.

The annual report of the Secretary of Commerce places aircraft far ahead in the indices of production for the fiscal year 1941 over 1940. Aircraft indices give 664 in 1941 over 263 in 1940, a 152 per cent increase, as compared to 99 per cent for the next highest locomotives, including tanks, with an index of 199 last year and 100 for 1940.

* President, Aeronautical Chamber of Commerce of America. These are excerpts from his recent address to the Economic Club of New York City.

New deHavilland Propellers

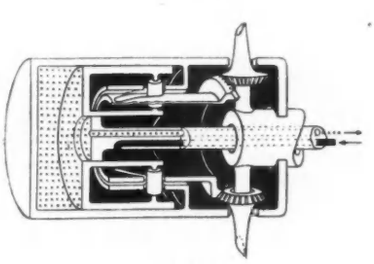


Courtesy of The Aeroplane (England)

1. Blade and blade thrust bearing
2. Blade bushing
3. Motor drive shaft
4. Motor cover
5. Blade plug
6. Balancing washers
7. Lead wool
8. Felt pad
9. Spider (Splined to motor drive shaft)
10. Barrel support block
11. Barrel support block shim
12. Dowel
13. De-icing slinger ring and spray pipe
14. Barrel bolts
15. Micarta sleeve
16. Laminated spring pack for gear segment
17. Dome
18. Dome plug
19. Piston
20. Piston gasket
21. Cam rollers
22. Cam roller bushing
23. Cam roller shaft
24. Stationary cam
25. Rotating cam integral with bevel gear
26. Stationary housing
27. Valve
28. Oil seal expander rings
29. Blade gear segment
30. Sleeve (moves with piston)

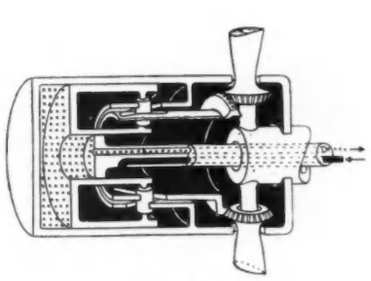
DESIGNED with larger blade areas to satisfy the need for efficient operation at high altitudes, two new propellers of six-blade counter rotating and four-blade hydromatic types have been developed by the Airscrew Division of the de Havilland Aircraft Co., Ltd., of England. The six-blade counter-rotating propeller, fitted with light-alloy blades fixed to a compact hub, is non-feathering. The full-feathering feature can be added, however, if an installation requires it.

The four-blade constant-speed de Havilland Hydromatic, illustrated here, is a full-feathering type incorporating the features, with refinements, of the earlier three-blade design.



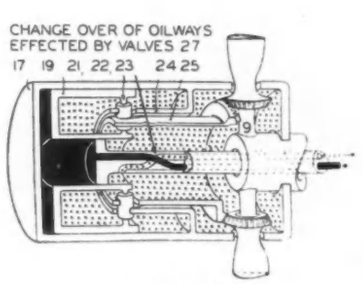
STAGE I

The flow of oil to the engine lubrication system is shown by xxx. That of the oil from the governor pump of the constant speed unit which pushes the piston forward to the coarse pitch position is shown in black. Piston moving from right to left.



STAGE II

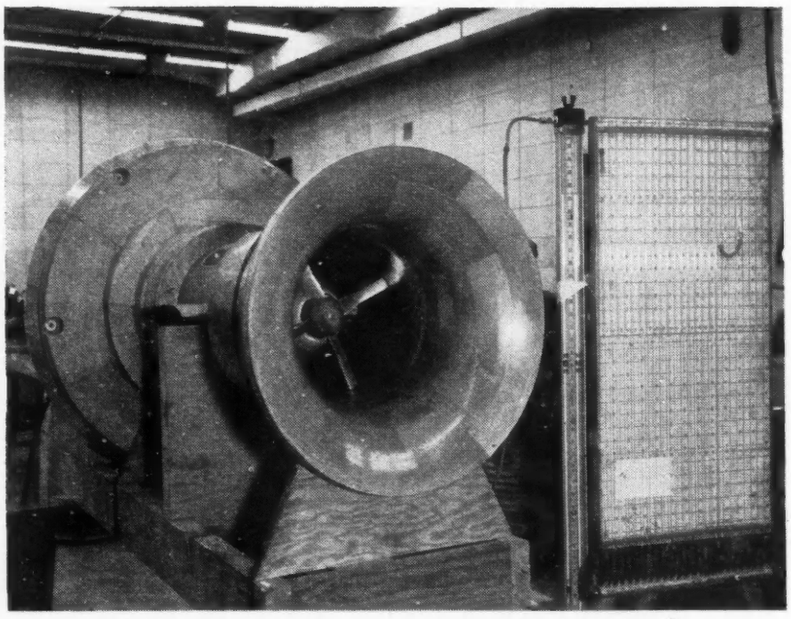
Blades turning from coarse pitch to feathered position. The oil from the independent high pressure pump (through the constant speed unit) pushes the piston forward past the sharp turn in the cam slot and against the centrifugal blade-moment, into the feathered position. Piston moving from right to left.



STAGE III

Blades turning from the feathered position back to coarse pitch. The oil from the independent high pressure pump (through the constant speed unit) pushes the piston back to Stage II, assisted by centrifugal blade-moment. Piston moving from left to right.

Does Ground T



This model test setup of a proposed wind tunnel-nacelle arrangement was used at the Vega laboratories to determine the wall effect upon pressures.

THERE are several reasons for perfecting integral units of the airplane by means of ground tests before they are flown on the airplane. The most important reason is to save flight test time, permitting more attention to be paid to strictly airplane problems during the flight program, and thereby expediting approval of the design project for production. Items such as performance determination, stability, stall characteristics, control forces, airplane vibration, sound proofing, and ventilation, which can finally be verified only in flight, make the program extensive without the added complication of detail development problems such as on the engine installation and other units of the airplane.

The average length of time required to develop an engine installation by flight testing is greater than that required to determine and perfect all other characteristics of the airplane. The value of this flight time, as shown in Fig. 1, varies greatly with the size of the machine. Furthermore, the value of the weeks or months of elapsed time spent in testing the engine installation may be even greater to the company than the actual cost of flight tests, especially in periods of emergency.

The Vega Aircraft Corp. for several years has recognized the advantages of the ground test stand for developing power units. For example, Veda-built cowl assemblies destined for shipment to England, to be used on the four-engined Armstrong-Whitworth "Ensign" transport airplane, were thoroughly proven on the stand before the design was finally released. Another example of Vega test stand activities is the novel test trailer which was built for the Unitwin Power Plant installation.

A complete mockup and test stand program also were made for a Pratt and Whitney engine installation in a late model airplane. As a contract for a large number of these airplanes was involved, the need for haste in starting production was quite apparent; hence, a program was outlined for determining as many flight characteristics of the engine installation as possible on a test stand. Preliminary experimental tests had already been conducted, such as powered wind tunnel model tests, blower tests on the carburetor air duct and oil cooler installation, engine and propeller vibration tests, etc.

The engine installation, as designed for production, consisted briefly of an N.A.C.A. type cowl, with cowl flaps at the trailing edge; a long carburetor air duct on the top, with its entrance at the cowl nose; an oil cooler on the bottom, with entrance back near the cowl flaps; and an exhaust collector aft of the engine, with a single outlet on the lower, outboard quadrant of the cowl.

The test stand was constructed of large diameter steel pipe, which supported the engine installation in the ground or climbing attitude. A small test house was arranged alongside, with controls and instrumentation necessary for the program. This test stand was aligned with the direction of the prevaling wind, and free from disturbing air currents from buildings. Test data were quickly correlated and distributed to various interested parties, and frequent conferences were called to discuss the results and decide upon necessary changes to the installation or to the test program. The test stand and the engine installation in the Vega airplanes are shown in the illustrations.

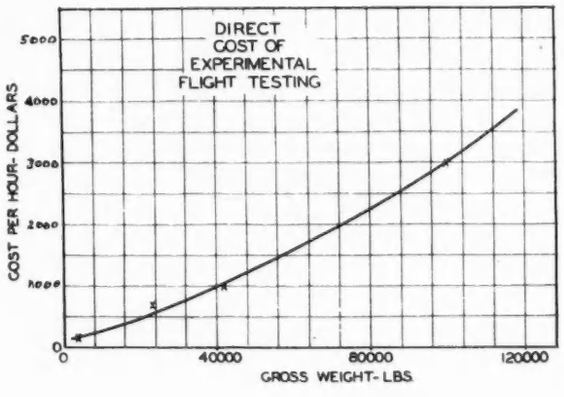


Fig. 1—Direct cost of experimental flight testing airplanes

Testing of Airplane Engine Installations Pay?

Experimental Investigation at Vega Laboratories and Cost Analysis Reveals Its Advantages Over Flight Tests

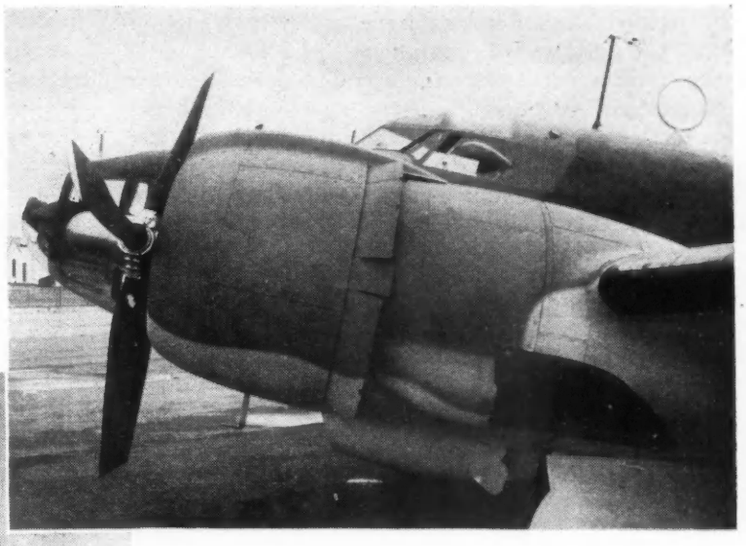
By James B. Kendrick*

The conditions of operation for cooling tests consisted of continuous runs at 60 per cent rated r.p.m. and approximately 20 per cent rated power for determining stabilized engine temperatures. Frequent short runs up to rated and takeoff powers were made to determine the functioning of equipment under these conditions. Between these runs it was necessary to idle the engine for extended periods to cool down to normal temperatures. Under these severe ground test conditions there were frequent delays due to service difficulties, such as fouled plugs, magneto and ignition troubles; but in general the tests ran off smoothly and results were obtained in a short time. Occasionally the wind direction and velocity caused operations to cease, because side wind or excessive velocity gave erratic results, since the stand was not arranged to be pointed into the wind.

A summary of the relationship between the test stand and flight data, Table I, shows that the test stand results gave fairly good agreement with flight results, indicating flight characteristics in all cases where reasonable similitude was obtained, and that most examples of poor correlation were due to poor similitude conditions. However, since the most important function of such tests is to indicate flight cooling characteristics, and since these conditions cannot be simulated accurately on a simple test stand, it may be concluded that, as an indication of flight cooling, the above method of testing engine installations is in general not sufficiently reliable to warrant proceeding confidently with fabrication on the basis of such test results alone. Ground cooling, and other tests where reasonable similitude is obtained, may be conducted in this manner with confidence in their reliability.

The reliability of pre-flight testing may be improved by the logical procedure of analyzing the critical flight

* Aerodynamic Engineer, Vega Aircraft Corp., Burbank, Calif. This article is an abstract of the paper, "Ground Tests vs. Flight Tests of Airplane Engine Installations," which was presented at the SAE annual meeting in January at Detroit.



Ground test setup for Pratt & Whitney engine installation in a recent model Vega airplane. The installation as it appeared later in production also is shown here.

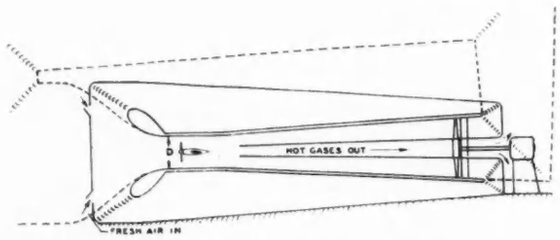


Fig. 2. Proposed closed return wind tunnel for testing airplane engine installations.

conditions carefully, separating the variables into factors of primary and secondary importance, devising a test procedure and facilities for reproducing as many of the factors as possible, estimating the degree of accuracy to be expected of the results, then judging whether or not the proposed test would be worthwhile. Model tests may sometimes be used to determine the relative importance of various factors. Several cases will now be considered as examples of the above method of procedure.

The primary factors affecting engine-propeller vibration are engine power, and r.p.m. conditions, aerodynamic excitation and damping, and propeller inflow velocity. If vibration data are to be obtained with preflight tests, flight velocities as well as accurate reproduction of interferences must be provided in order to insure reliable engine amplitudes and propeller stresses. This suggests either an airplane of the general configuration in question, or a large wind tunnel with a powerful auxiliary motor, as the necessary test equipment for accurate results.

Considering next the similitude conditions which should be satisfied for an accelerated service test on an engine installation (performed under transport operation conditions, with two-hour cycles consisting of takeoff power for one minute, rated power for five minutes, cruise for 100 minutes, idle for 10 minutes, etc.), the primary factors will probably be engine power conditions, flight velocities and pressure differentials, fuel consumption and vibration characteristics.

The primary factors affecting engine cooling, oil

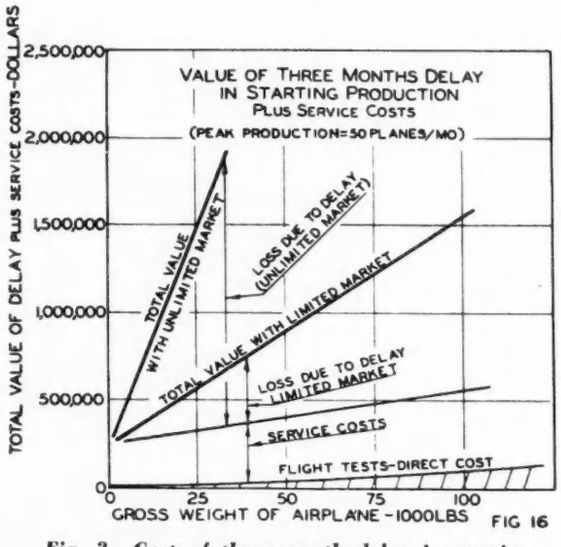


Fig. 3—Cost of three-month delay in starting production, plus service costs.

cooling and compartment temperature for a given nacelle arrangement, are usually engine power, fuel consumption, airplane and slipstream velocity, and pressure differential across the engine or cooler. Secondary factors are usually altitude conditions, angle of attack, slip stream rotation, carburetor preheat, etc.

One method for creating higher velocities on a ground test stand is to place the engine and propeller installation at the throat of an open return type wind tunnel, relying upon the engine power itself to provide the sole motive power for the tunnel. A model test set-up, as illustrated here, of a proposed wind tunnel-nacelle arrangement, may be used to determine the wall effect upon the pressures and thereafter the cooling data may be interpreted to give free air results.

Another proposal for increasing the test velocities is to provide an adequately powered wind tunnel, preferably of the closed return type, with the test installation at the throat, supplying its share of the total

Table I—Correlation Between Test Stand and Flight Test Data

Item	Ground-Flight Correlation	Apparent Similitude
Shakedown Test	Fair	Good
Ground Cooling	Good	Good
Cylinder Base Cooling	Fair	Poor
Cylinder Head Cooling	Good	Poor
Cylinder Temperature Distribution	Poor	Poor
Oil Cooling	Good	Poor
Low Altitude Carburetion	Good	Fair
Fuel Flow at Altitude	Fair	Fair
Exhaust Back Pressure	Good	Good
Vibration (27/16 Order)	Poor	Poor
Propeller Stresses	Fair	Poor
Accessory Temperatures	Fair	Fair
High Altitude Carburetion	No Test	No Test
Carburetor Heat Rise	Fair	Fair
Vibration (3½ Order)	Fair	Poor

power. The most efficient arrangement of this type in current use is the single return duct, with guide vanes at the corners, and a long, gentle expansion between the test section and the first corner. Although very suitable for test purposes, one disadvantage of this type of tunnel is its tremendous size, to accommodate a throat diameter large enough for one engine and propeller testing.

As a means to reduce the size and cost of the closed return wind tunnel, an Eiffel type tunnel of efficient form may be provided, Fig. 2, enclosed within a building slightly larger than the tunnel itself, the walls of the building forming an expanding annular return passage for the flow. This would present a very compact arrangement, of approximately one-third the volume of a normal single closed return wind tunnel having the same energy ratio. Further reductions in overall dimensions may be possible by the use of boundary layer control on the inside and outside of the conical section, permitting its length to be reduced by reason of a wider cone angle, without sacrificing tunnel efficiency.

When altitude conditions are a primary factor in engine cooling, it may become necessary to simulate

Table II—Comparison of Various Types of Engine Test Equipment

Test Condition	Type of Equipment: Simple Venturi	Auxiliary Jet	Closed Ret. Aux. Power
Similitude			
Airspeed	Climb	Any	Any
Airflow	Fair	Poor	Good
Vibration Interference	None	Fair	Good
Cooling Air Temp. Control	None	None	Good
Usefulness			
Experimental Development	Good	Poor	Very Good
Vibration Tests	Poor	Fair	Good
Service Tests	Fair	Poor	Good
Relative Cost	2	1	3
General Preference	2	3	1

altitude pressures and temperatures within the tunnel. In such cases, the above proposal is advantageous. The evacuating equipment and likewise the refrigerating equipment, will be less expensive because of the lower volume within the shell. The reduced surface area will permit a further reduction in refrigeration costs, from the standpoint of refrigerating capacity and insulation costs. The tunnel power required to obtain a given speed may also be reduced when operating at low pressures.

The methods for ground proving of engines described herein apply as well to radial as in-line engines, whether liquid or air cooled. Likewise, small engines may be tested by these methods, in which case the test equipment involved will be reduced in scale and cost, in agreement with the size of engine and the value of the tests.

From the above methods for creating flight conditions for the powerplant, or other methods which may be devised, a wide selection of possibilities will be available to satisfy economic and time considerations, as well as test conditions. With such facilities, the following characteristics may be proven on the test stand before flight testing is begun: Shakedown tests, engine cooling, oil cooling, fuel flow and vapor lock, carburetor icing, exhaust back pressures, turb-supercharger functioning, exhaust jets, engine detonation under service conditions, measurement of drag of engine installation, propeller and engine vibration and serviceability of installation.

In consideration of the numerous ground tests which may be conducted, a careful selection of test equipment to best serve all the needs is required, and a re-evaluation of the total benefit of such equipment combining its usefulness for experimental development with that of service testing. A comparison of various types of wind tunnel, Table II, indicates that the closed return type with adequate power will give satisfactory similitude for all major test conditions, such as engine cooling, vibration, carburetion, service test, etc. The tunnel throat should be approximately 25 ft. in diameter, in order to permit angle of attack variation and accurate vibrations and service tests. Assuming an atmospheric tunnel of energy ratio 3.0, the power required for a speed of 250 m.p.h. will be 16,000 hp.

An analysis of the normal operating costs for such a tunnel (including depreciation and interest on the investment) shows that such tests may be conducted more economically than even the direct costs of flight testing (Fig. 1), the advantage becoming increasingly great with the size of the airplane involved. Another factor is the cost of tying-up a valuable prototype airplane for detailed tests and changes, with prototypes valued at up to several million dollars, this factor becomes one of great importance.

The above analysis seems favorable for the engine test wind tunnel, but even more convincing is the argument presented by a statement of combined value of flight tests, losses due to production delays, and service costs, as shown in Fig. 3. If some difficult engine installation problem delayed production for 90 days, the resulting loss to the company might exceed the cost of an adequate wind tunnel. Likewise, if some undiscovered service difficulty arose after a large number of airplanes were delivered, the cost of rectifying this condition in the field might amply justify a considerable investment in test facilities of the type described. These may be unusual examples, but such incidents may be cited in the history of almost every large airplane manufacturer, where the pressure to start production has caused a disproportionate expenditure due to a long flight test program or unforeseen service difficulties. It is safe to say that on the average, development and service tests may be accomplished in the wind tunnel in a shorter elapsed time, and at a fraction of the total cost, than development tests only conducted on the airplane.

Progress in Structural Design Through Strain Gage Technique Discussed at SAE

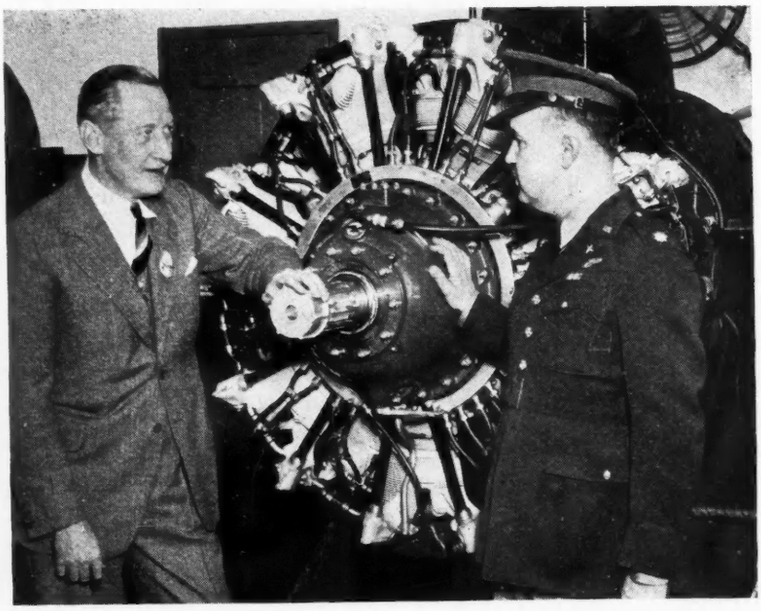
PROGRESS in structural design through strain gage technique was discussed by C. R. Strang of the Douglas Aircraft Co. The author held that the greatest possible aid to increased ease in production is to start with the original design and simplify the structure itself, rather than spend months working out the best theoretical design.

In conducting tests, resistance units of fine wire are cemented to the stressed surfaces and connected in a suitable bridge circuit. Since the cross sections of these wires are varied by any movement of the member under test, it is possible by means of an electronically amplified bridge circuit to measure the change in resistance and, consequently, the strain in the various members. The line of maximum stress can be determined by arranging three resistance units in a delta formation. Furthermore, by mounting gage units on both sides of thin sheets it is possible to cancel out the effects of buckling. By suitable channeling of the many circuits used in flight tests, one oscillograph may be used not only to check the various strains but also to measure the acceleration, changes in pressure in hydraulic lines, etc.

The author concluded his paper by offering solu-

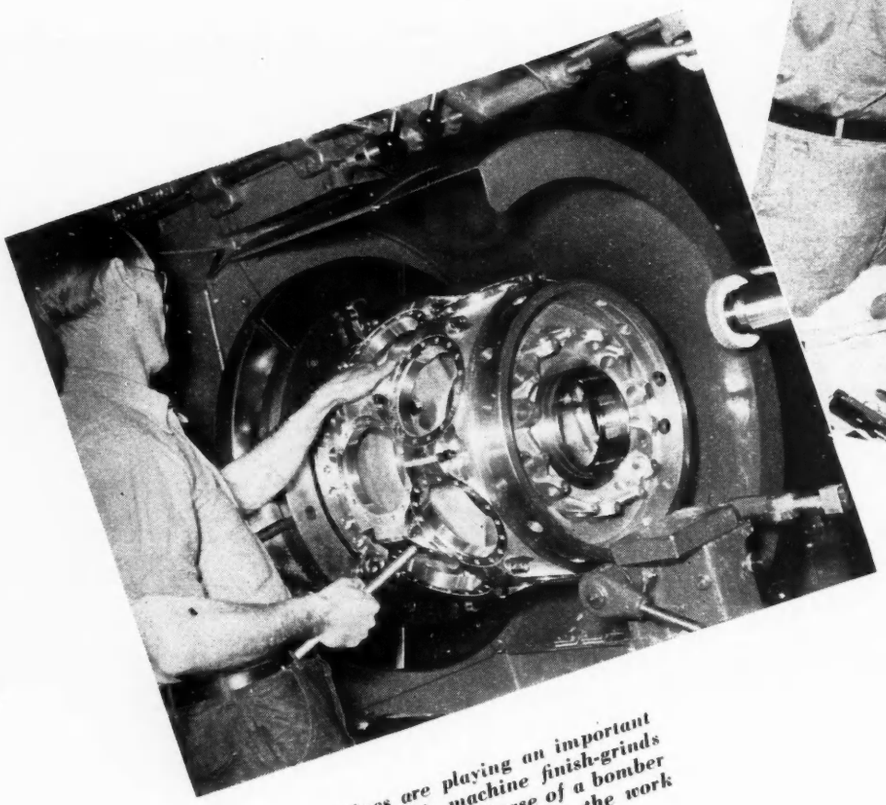
(*Turn to page* 56, *please*)

Bomber



Harlow H. Curtice, Buick president and general manager, and Maj. E. H. Bowman, resident Air Corps representative, inspect engine which has just completed its acceptance test run.

(Right) One of the major sub-assemblies in Buick production is here shown taking form. Expert workmen carefully assemble the important power section which when completed goes to the final assembly line for installation in an engine.



(Above) Special machines are playing an important part in war production. This machine finish-grinds the bearings on the assembled crankcase of a bomber engine. Operator is preparing to remove the work from the machine.

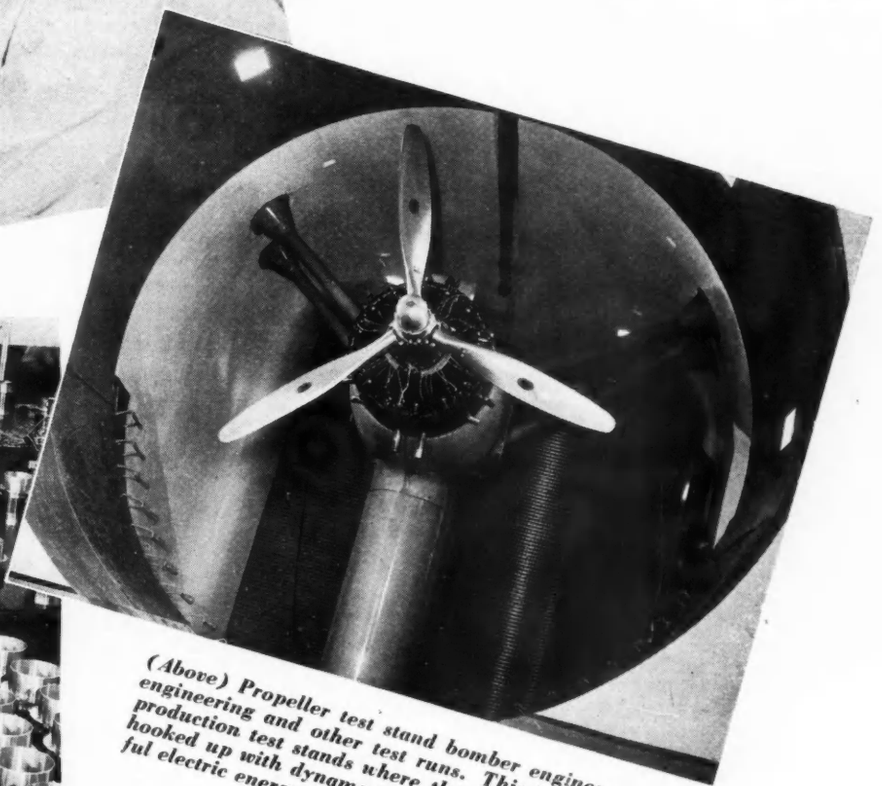
(Right) Production in quantity of finished cylinder barrels which have passed inspection and are ready for the next productive operation for the Army Air Corps.

Engines by Buick

Melrose plant gets into production on 14-cylinder P & W's

(Right) Cylinder heads are checked and rechecked for dimensional accuracy before approval for production. Here highly trained specialists are shown inspecting a table full of finished cylinder heads in the assembly plant.

(Left) Here is shown a Buick inspector checking the parallelism of gear teeth on a set of finished gears prior to assembly into the engine.



(Above) Propeller test stand bomber engines are given engineering and other test runs. This is in addition to production test stands where the engines under test are hooked up with dynamos to recover in the form of useful electric energy thousands of horsepower which otherwise would be wasted.

Airbriefs

By HENRY LOWE BROWNBACK

Fins

One design change which is very noticeable on the newer bombers is the lengthening of the fin. In order to make these big machines laterally stable the wings were given quite a bit of dihedral or "tilt up" toward the wing tips and this made certain wings have some instability in yaw or, to use the motor car man's language, to "wander." Many remedies have been proposed from exaggerated gull wings up and down but the final word seems to be the radical lengthening of the fin.

Shake-Proof Fastenings

I, too, wonder about the ability of the modern mechanic to safety-wire a turnbuckle properly, form a cable end or to "safety" a nut with three or four light centerpunch marks. Modern aircraft are a maze of clever shakeproof fastenings and catches. You may soon see an article dealing with these little devices which will open the eyes of the average automotive expert.

Secrets

And that makes me think of something else. I have been looking over some advance material with the editor to be used in the big special issue of AUTOMOTIVE AND AVIATION INDUSTRIES next month and you don't want to miss the things you will see there—everything from a B-19 to a motorcycle. That issue is going to be something eminently worth while.

Non-Skid Flooring

Most of the old-timers can remember the plywood or aluminum wing walks and cockpit floors which got so slippery in wet weather that most of us think with chagrin of some time or other when we have fallen through a wing cover or else have had a bad jar inside of the plane. In fact, several pilots were killed or injured because their cavalry spurs got caught in the slatted floors of one of the World War training planes. Modern planes are fitted with non-skid flooring, a most popular type of which was developed in England.

Here is a stunt taken from the books of the Down East fishermen. If you have a painted or varnished surface which will get wet and must be walked upon and which must look neat just mix a little emery or powdered carborundum in the paint and keep it stirred up as you paint. It is scarcely visible, but makes an otherwise deadly surface very safe.

Hydraulic Controls

Some time ago Mr. Heldt and the writer wrote an article on hydraulic controls dealing with the high pressure type. There is a most ingenious and interesting hydraulic control system of the low pressure type which is used in aircraft to some extent, but not so widely as on boats for distant type fuel gauges.

It is composed of two sylphons and a tube, and so made up that it is completely filled with liquid and sealed with one sylphon extended when the other is compressed. Thus when effort is applied to the extended sylphon to compress it, the effort is transmitted by the liquid to the other sylphon to extend it and there is very little effort lost and no play of any kind. These rigs are used on the fuel tanks of ships and submarines as well as on some airplanes for fuel gauges and for controls where the effort involved would not injure the sylphon elements. I first saw this device about four or five years ago and was much impressed with it.

Blackouts

Here is a tip to the factory manager who is painting his windows for the blackout. Windows painted on the inside with black paint make excellent mirrors, which can plainly be seen at tremendous altitudes in the moonlight. Paint them on the outside with flat black!

Trick Rivets

Much information has appeared about the explosive rivet employed for blind riveting of certain airplane structures. One invention always leads to others and I have recently been sent data about another type in which a little nickel alloy tubular rivet and a finishing nail formed the two components. It is simple and effective. Perhaps we shall hear a howl of woe from some of the young riveters who have been enjoying a more or less continuous Fourth of July celebration.

Simplifying Manufacture

The Chinese are said to have an old proverb which says in effect that "he who sticks honorable neck out is sure to get something hung on it." I'm going to risk it and stick mine 'way out. We are faced today with an unprecedented shortage of strategic materials, skilled men and production machinery, so it behooves us to find novel means of making things and to try unorthodox materials and methods.

Much actual fighting equipment has been designed and is being produced under the orders and to the specifications of old-time ordnance and fighting machine designers who grew up in a school where the original design had to give results and where things were built and not produced. Instead of changing this procedure and designing our material to do the job and at the same time to be produced, we too often are trying to expand the old system of manufacture or to manufacture material designed for building by rapid production methods.

Actually we are doing the job as though we were faced with providing the whole world with millions of motor cars and turned to the designer of the Hispano Suiza or Rolls Royce and asked him to handle the job. He wouldn't know Ford-Chevrolet-Plymouth practice and wouldn't have much sympathy for it or faith in what it produced. So he would just try and produce his millions of cars by putting up immense factories with myriads of machine tools, using many times as much primary material as he would with the mass production stamped and welded technique and employ many times as many skilled men as he would otherwise. He KNOWS that his Rolls-Hispano will work and he isn't certain that the Ford-Chevrolet-Plymouth will, so he isn't going to "stick honorable neck out." In today's program there are too many light parts such as gun and camera mounts being hacked out of heavy castings or forgings when they could be built up and too many close tolerances when "almost any old thing" would do.

If our production chiefs would have the courage to turn over the final design of machines to production men and let them change them as their experience dictates in spite of the wails of the very competent experts, who capably designed them to be built we would save time, money and materials. A Cadillac back axle will last as long, carry as much load and is just as quiet as that used in the Rolls, but it can be made in about 20 per cent of the time out of castings, forgings and stampings which waste little material while the other is a masterpiece of wastefulness as far as production is concerned, although it is a mechanical marvel. Like many machines it is too good for the job it has to perform. Much of our war material is far too good for the job and too difficult to produce. (*Turn to page* 64, *please*)

Service Plans to Help Automobile Dealers

By E. L. Warner, Jr.

PASSENGER car manufacturers realizing that service would play an increasingly important part under a war-time economy have been pushing maintenance programs for more than a year. This is now taking concrete form in such campaigns as Chevrolet's "Car Conservation Plan," Hudson's "Nu-Conditioning," Pontiac's "Prescribed Service," Buick's "CYC" (Conserve Your Car), the Studebaker "Action Program" and several others. These are designed to help dealers weather the economic storm and also to keep the customers of the automobile companies satisfied with their product for the duration.

Field men, zone managers and factory executives have been covering the nation to sell dealers on the importance of these service programs. National and local advertising, direct mail promotion pieces and personal contact work, often by former new car salesmen, are carrying the service message to the automobile owners. Chevrolet is helping educate its 8,300 dealers in service promotion by showing a series of 26 silent films to them during the year so they can help keep satisfied the owners of 8,376,661 Chevrolets now on the highways.

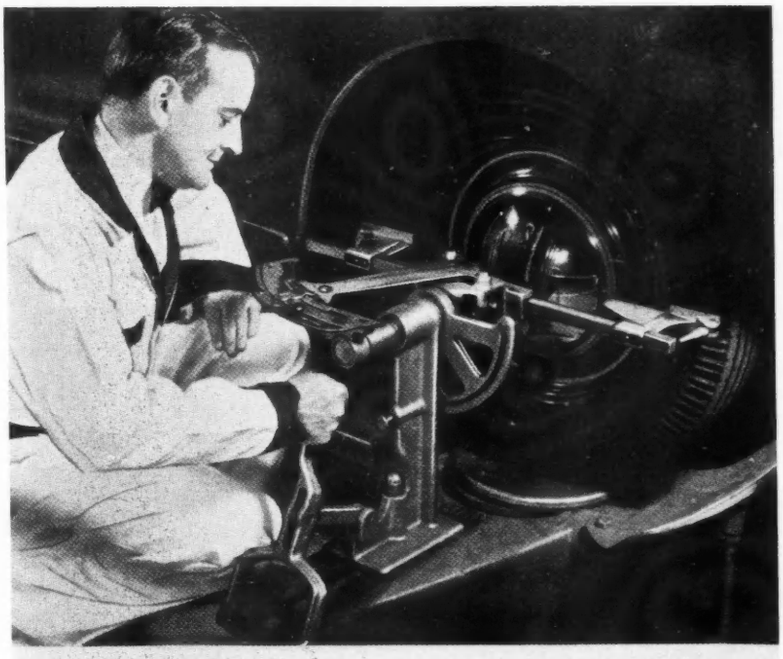
Pontiac has taken a realistic view of the situation with its "Prescribed Service" plan, which recognizes that in the past some dealers have oversold service with a consequent loss of customers. A survey by Pontiac showed that more than half of the new car buyers in the industry have been lost to dealers as service customers by the end of the first year. In order to keep these owners as service customers and also as better prospects for repeat sales, Pontiac worked out three classes of service to fit the pocketbook of the owner.

First, there are "Essential" services, such as chassis lubrication, carburetor inspection, changing engine oil and transmission lubricants. Second, there are "As Needed" services, recommended on the basis of the individual requirements of the car, such as replacing spark plugs and piston rings, reconditioning valves, adjusting brakes and front wheel alinement. Third, there are "Insurance" or luxury services, such as washing and polishing, body and chassis tightening and replacing radiator hose. "Prescribed Service" replaces the old system of handling various types of maintenance work on an arbitrary mileage basis, regardless of the way the car was treated by the individual driver.

Pontiac's plan also will help conserve replacement parts. Distributor breaker points formerly were replaced on a recommended mileage basis. Actual tests of 102 sets of replaced points showed that only six sets of replaced points could not be repaired and used again.

Chevrolet and Dodge are urging a budget plan for financing service and accessory costs by owners on a monthly installment basis, with a small down payment. Chevrolet also suggests credit cards for customers to handle small service bills. Hudson's "Nu-Conditioning" program calls for an appraisal of the owner's car on the amount of service needed

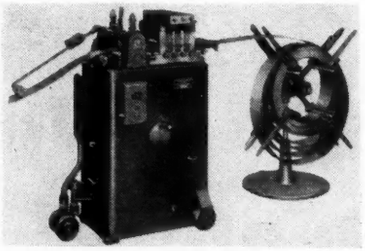
(*Turn to page* 66, *please*)



To conserve rubber—to make your tires last longer—have your steering and wheel alignment checked with this special equipment at your Chevrolet dealer's.

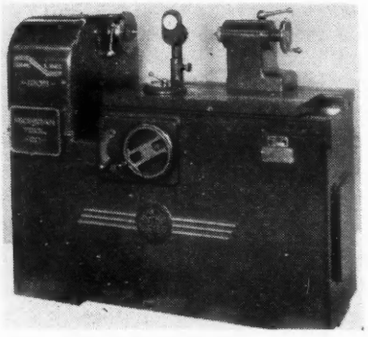
The type of illustration used in Chevrolet newspaper advertising regarding the "Car Conservation Plan"

MEN and



No. 308 Littell continuous straightening machine with automatic centering reel.

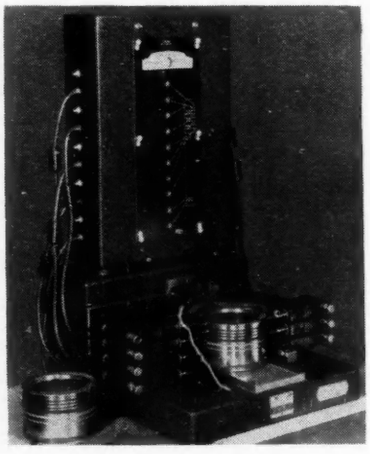
BUILT by the F. J. Littell Machine Co., Chicago, a new continuous feeding and straightening unit is so arranged that either a five- or seven-roll straightener can be used. The machine will handle stock up to eight inches wide and is driven by a ¾-hp., three-phase, 60-cycle, 220-440-v motor running at 1725 rpm. A 6-to-1 variable-speed transmission provides speeds from 10 to 60 fpm.



Model 1205 Sine-Line gear checking machine.

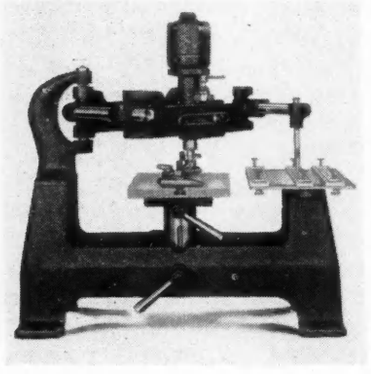
AS AN addition to its line of gear-checking equipment, a new Sine-Line lead checking machine, Model 1205, designed to check right- and left-hand spiral gear leads from zero to infinity, has been announced by the Michigan Tool Co., Detroit. Of the adjustable sine-bar type, the machine eliminates any need for master rolls, discs, or lead screws in checking gears; it can be used with the Michigan gear-checking recorder.

The standard machine will accommodate gears up to 18 in. in diameter. Standard bed length is 24 in. Bed lengths of 36 and 48 in. are available at extra cost.



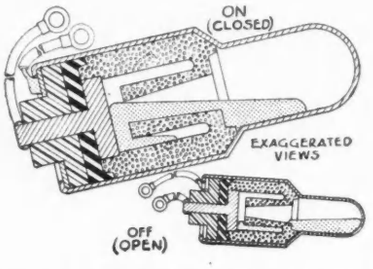
This Sheffield Multicheck is used in checking the dimensions of aircraft engine pistons.

THE SHEFFIELD CORP., Dayton, Ohio, has announced a Multicheck gaging machine for checking simultaneously ten dimensions of an aircraft engine piston. Each gaging unit operates independently, although all units are connected to a master light at the top of the panel which operates only when a tolerance has been exceeded. The signal lights controlled by the individual gages show red, amber, or green to indicate dimensions which are undersize, within the tolerance, or oversize. The carboloy-tipped measuring arms are set with high and low master gages.



Preis pantographic machine handles engraving, electrical marking, and acid etching.

THE H. P. PREIS Engraving Machine Co., Newark, N. J., announces an improved pantographic machine designed for rotary engraving, electrical marking, or acid etching. The ball-bearing-mounted pantograph, providing reductions from 1.8 to 1 down to 5 to 1, may be fitted with quickly interchangeable heads. Designed for mounting on a bench, the machine is a compact unit 21 in. long, 14 in. wide, and 15 in. high.

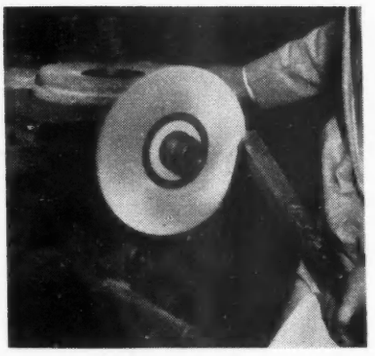


This new Durakool mercury switch is designed for use where erratic action might be caused by severe vibration.

A DOUBLE-FLOW mercury switch which prevents double contacting caused by machine vibration has been developed by Durakool, Inc., Elkhart, Ind. When the switch is tipped to the off position, two tails of mercury pulling in opposite directions break over a ceramic barrier. It is said that this design definitely prevents the two pools of mercury from making contact again until the switch is moved to the closed position.

USED with the proper abrasives, a new type of fiber industrial brush, called the Osborn Fascut Treated Tampico Section, will remove tool marks from aircraft motor parts, such as connecting rods, tappets, cams, etc. According to the manufacturer, The Osborn Brush Co., Cleveland, Ohio, the new brush will remove burrs without damage, when used without abrasives, from metals such as aluminum and Alclad. Osborn engineers say that a new treatment used in the manufacture of the brush supports the individual strands of Tampico, thus preventing it from fluttering and throwing off compound; furthermore, the brush resists heat and temperature changes more effectively.

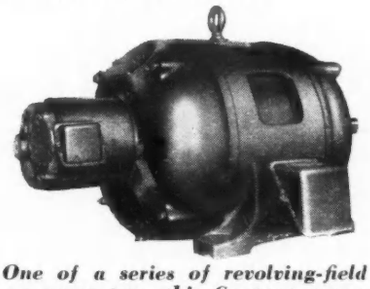
The brushes are available in diameters of 4, 6, 8, 10, 12, 14, 15, and 16 in.



Offered by the Osborn Brush Co., the Tampico fiber industrial brush is suited to many applications in the automotive and aircraft industries. It is shown here undergoing a break down test.

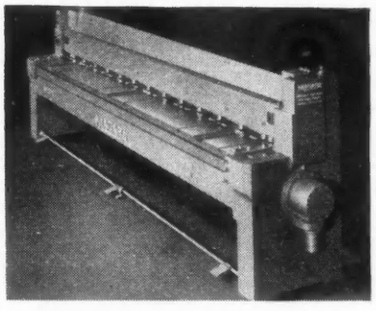
MACHINES

CENTURY ELECTRIC CO., St. Louis, Mo., is manufacturing a new series of revolving-field a.c. generators. Available in sizes from 7½ to 75 kva., and with four, six, or eight poles, the generators run at 1800, 1200, or 900 r.p.m. in the generation of 60-cycle current. They are wound for the various standard voltages—single-phase, two- and three-wire; three-phase, three- and four-wire; or two-phase, four-wire. The neutral may be brought out for three-phase, four-wire systems for light and power. The generators can be designed for any desired power factor; voltage regulation, however, which is generally used for best lighting service, is governed by the power factor.



One of a series of revolving-field a-c generators, this Century generator has been designed for continuous duty in isolated plants, or for use as a supplementary power supply.

THE "SPEEDWAY," a new light-weight wire-rope electric hoist, available in capacities ranging from 250 to 1000 lb., is manufactured by the Wright Mfg. Division (York, Pa.) of the American Chain and Cable Co., Inc. Furnished for lug, hook, or trolley suspension, the hoist is driven by a 60-cycle, 110-220-v, single-phase, or a 60-cycle, 220-440-v, three-phase motor.



The Niagara Machine & Tool Works, Buffalo, N. Y., announces the addition of a new line of Series No. 3 power squaring shears. Incorporating many of the features found in other Niagara shears, the machine is built in sizes accommodating lengths from 4 to 12 feet, 14 to 18 gage.

ADEL PRECISION PRODUCTS CORP., Burbank, Cal., is offering two new hydraulic selector valves fabricated from dural bar. Utilizing identical component operating parts, the two designs differ only in the arrangement of the ports. The smaller is adapted to multiple assemblies and manifolding; the larger unit is for individual installations. The valves will handle pressures up to 3000 psi at a flow of 6 to 10 gpm. At a pressure of 800 psi, an operating torque of only 16 in.-lb. is required.

A SERIES of newly designed oxyacetylene cutting tips which increase the cutting speed of machine torches by 20 to 30 per cent has been developed by Air Reduction, New York, N. Y.

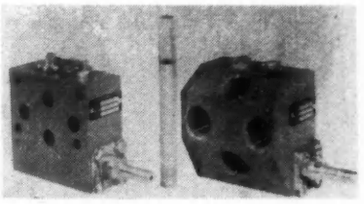
The Airco "45" high-speed tip ejects a narrow, high-velocity stream of oxygen, virtually free of exit turbulence. It is said that this design permits faster cutting with a saving in oxygen consumption. Tips are available for cutting thicknesses up to 8 in.

A NEW standard line of dual-ram broaching machines, known as the VAD series, has been designed by the Colonial Broach Co., Detroit. The peak capacities of all eleven sizes have been increased. The smallest machine provides a working force of three tons through a 36-in. stroke; the largest, a force of 25 tons through a 66-in. stroke. Column widths of the machines have been increased so that the wide broach bars now in common use may be more rigidly supported. Entirely new cylinder design is effected with the use of seamless-steel tubing and welded construction for leakproof operation. Relocation of the drive motor has reduced the amount of floor space needed for installation.

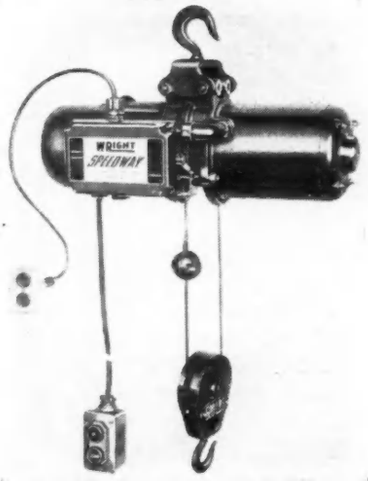
THE GISHOLT MACHINE CO., Madison, Wis., is manufacturing a new double-end boring bar for use with saddle-type turret lathes. The bar fits into the standard flanged tool holder on the turret, then through the turret, and is held on the opposite side by a short holder having four screws to grip the bar firmly.

(*Turn to page 58, please*)

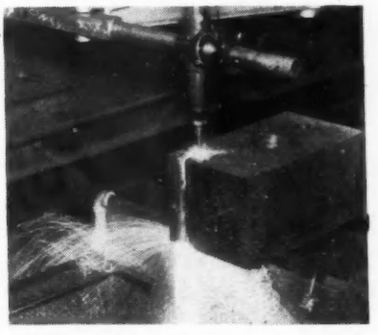
New Gisholt double-end boring bar for use with saddle-type turret lathes.



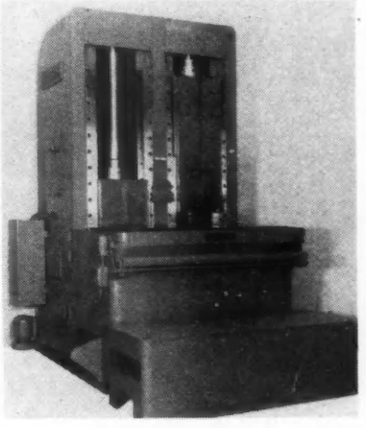
Comparison with a king-size cigaret hows the compactness of these Adel hydraulic selector valves.



Portability, flexibility, and accessibility are claimed for this new "Speedway" hoist.

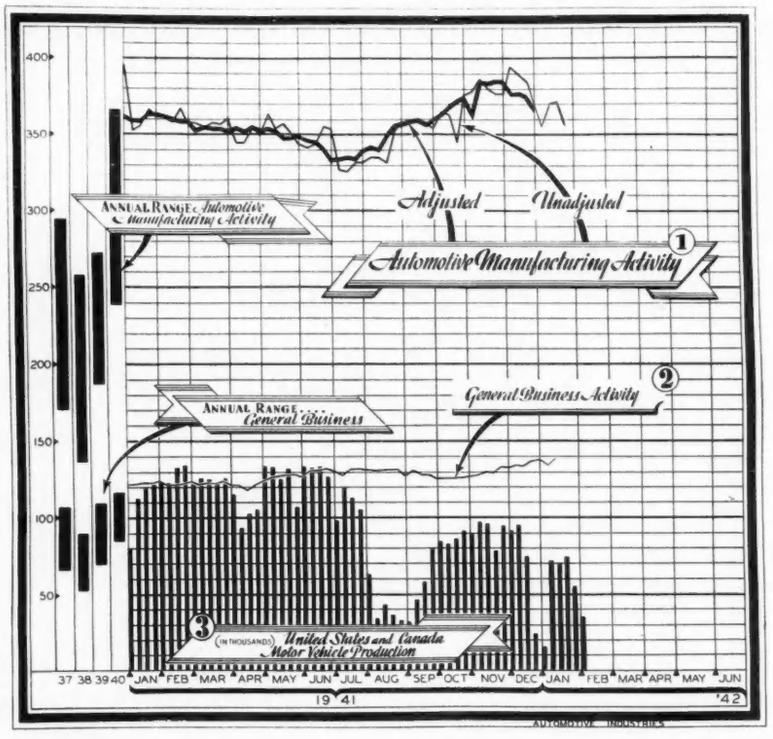


The Airco "45" high-speed machine cutting tip with a divergent nozzle is shown cutting through a piece of 6-in. alloy steel block.



One of a new line of Colonial broaching machines, this unit has been redesigned for increased production.

[*Our own view of automotive production and sales; authoritative interpretation of general conditions*]



Weekly Indexes of Automotive General Business

Manufacturers Plan All-Out War Effort

MARKING its final flourish as a producer of goods for civilian consumption, the automobile industry turned our approximately 15,000 passenger cars in the first 10 days of February. After the last car went down the final assembly line, plant maintenance men took over in many factories and began the task of machine rearrangement and clearance of space for the conversion of facilities to all-out war production. Little consideration is being given to eventual resumption of passenger car production when peace finally comes. Machinery that cannot be retooled for war production is being put in storage, in many cases outdoors due to lack of inside space and sometimes without the protective coating of grease to prevent rust and deterioration, so rushed are the plants with their war orders.

Production for the first half of February was estimated at 62,000 units, but this was expected to decline in the last half of the month due to the cessation of passenger car output. The industry was allotted 53,435 medium and heavy trucks to build in February, providing the manufacturers could obtain materials. In addition, military vehicles are being produced at a rate of about 30,000 units monthly. Light truck manufacture, like that of passenger cars, was banned after Jan. 31 by the War Production Board, but the companies were allowed an additional 10 days to complete their January quotas if the parts and material were on hand and the work would not interfere with war production. A quota of 54,710 medium and heavy trucks has been set for March, but these vehicles will be used as a reserve truck pool for future use and the tires and tubes must be returned to the manufacturers after delivery to the dealers.

Production in the week ending Feb. 7 was estimated at 37,500 units, with Ford contributing the major share by assembling 14,400 units, more than half of them passenger cars on the January quota. Chevrolet turned out 5500 vehicles, nearly all trucks, followed by Dodge, Yellow Truck & Coach, Willys, International, Buick, and Hudson in that order.

The conversion process may take from a few weeks to six months, depending upon what war material is to be produced in place of automobiles. Studebaker required only 10 days to change over its passenger car assembly line to military trucks due to the similarity of product. Chief bottleneck in the military truck field is adequate facilities for producing gear boxes, transfer cases, and axles for the 4 x 4 and 6 x 6 military vehicles. On the other hand, Studebaker built three new plants for the manufacture of Wright aircraft engines because only 64 of more than 3000 automotive machine tools were adaptable to the aircraft work. Other parts of the Studebaker South Bend plant will soon be made available for armament production.

Chrysler Corp. is tearing out automotive production facilities and rearranging machinery in all its Detroit plants and at Evansville, Ind., to make them fit into the corporation's war program. Chrysler has 19,700 machine tools, of which 11,081 are being used for war production or have been allocated for that purpose. Fifteen hundred machines are producing spare parts for Chrysler cars now on the road and the other 6000 will be listed with the industry's listing service for possible use by other manufacturers. The

(*Turn to page 52, please*)

[1] 1923 average = 100; [2] Prepared by the *New York Times* weekly business index; [3] Estimated at the Detroit office of AUTOMOTIVE *and* AVIATION INDUSTRIES.

Chrysler, GM Plan Huge War Plants

Buildings Designed for Aircraft Engine, Parts Production; Kanzler Makes WPB Automotive Branch Appointments

Chrysler Corp. joined the growing list of automobile makers to enter the aircraft engine field with announcement by Lieut.-Gen. William S. Knudsen that the company will build a new $100 million plant at Chicago to manufacture Wright 18-cylinder air-cooled engines. This is part of the enlarged four-engine bomber procurement program. Ford, Packard, Buick, Studebaker, and Chevrolet already are making airplane engines, while Hudson, Nash and Cadillac are turning out aircraft engine parts.

The new Chrysler plant will require 2 million sq ft of floor area, somewhat less than the Ford Willow Run bomber plant, and will employ 25,000 persons. Knudsen estimated the plant probably would be in production in nine months. The plant will be financed by the Defense Plant Corp.

In order to increase the production of aluminum castings for aircraft engines, Buick Motor Division of GM will build a $10 million foundry at Flint. Harlow H. Curtice, Buick general manager, said that the plant probably would be ready for production by summer. Employment probably will be double that of Buick's automotive foundry. It will enable Buick to supply its new aircraft engine plant at Melrose Park, Ill., and the Chevrolet plant at Buffalo, with aluminum castings.

Addition of another manufacturer as a source of liquid-cooled engines for army fighter planes was revealed when Knudsen said in a speech before the Engineering Society of Detroit that a second U. S. liquid-cooled engine besides the Allison is getting into production. Packard already is producing the British-designed Rolls-Royce liquid-cooled engine. Ford, Chrysler and Continental all have been experimenting with liquid-cooled power plants.

International Harvester Co. has received a government contract for upwards of $80 million to manufacture tanks at Davenport, Ia. Final assembly will be in the car shops of the Bettendorf Co., which is being acquired by the government. Employment there will total 4000 men. Subcontracts in nearby Rock Island and Moline, Ill., will employ another 4000 workers.

Goodyear Tire & Rubber Co. is rearranging its tire plant at Jackson, Mich., for the manufacture of cannon, according to P. W. Litchfield, board chairman. Production will begin when machinery is available.

The Automotive Council for War Production, the AMA advisory body on the war program, has added four new members—Joseph W. Frazer, president of Willys-Overland Motors, Inc.; I. B. Babcock, president and general manager of Yellow Truck & Coach Mfg. Co.; Arch T. Colwell, vice president of Thompson Products, Inc., Cleveland, representing the SAE; and H. W. Knapp, secretary-treasurer at McQuay-Norris Mfg. Co., St. Louis, representing the National Standard Parts Association.

Building up the technical and administrative staff of the Automotive Branch of the War Production Board, which eventually may number 100 men, Ernest C. Kanzler has appointed Irving J. Reuter, William C. Klann, E. C. Brandt, Charles B. Hartner, and Fred L. Flanders as his associates. Reuter, who has been living at Biltmore, N. C.,

(*Turn to page* 51, *please*)

GM Institute to Start New Class

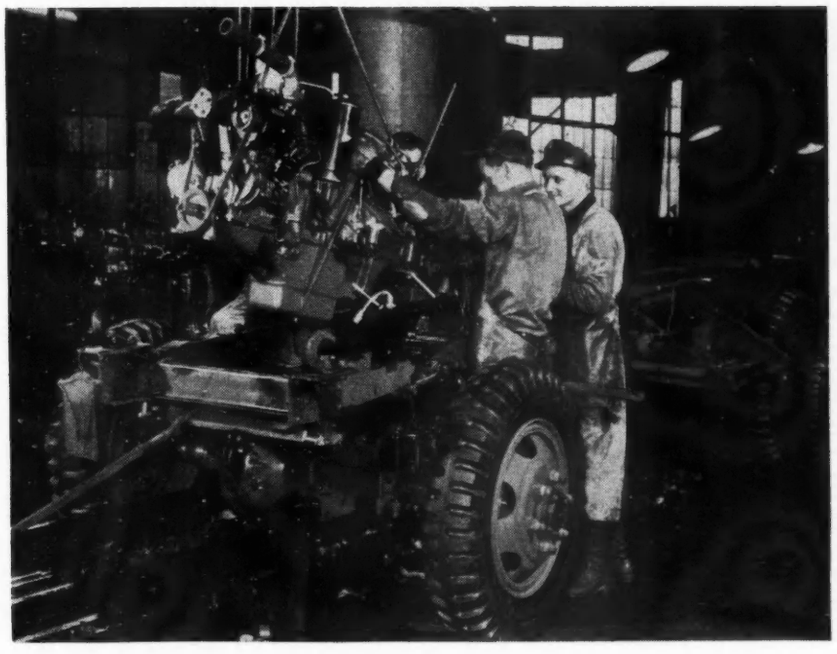
General Motors Institute at Flint is starting a new class in cooperative industrial and product engineering, opening in March, to help meet the demand for skilled workers by the war production program. Alternate periods of working in the plant and classroom work will mark this program, which already has 1100 students enrolled. GM Institute, with a staff of 78 members, gave training to 15,909 men and women during 1941. In addition, 6473 persons were reached in training conducted by individual GM plants.

U.S. Rubber Buys Plant

United States Rubber Co. has purchased the Hogansville plant of the Callaway Mills in Hogansville, Ga. Acquisition of the plant and its equipment will enable the company to make substantially all of its own duck for belting, hose and other mechanical goods.

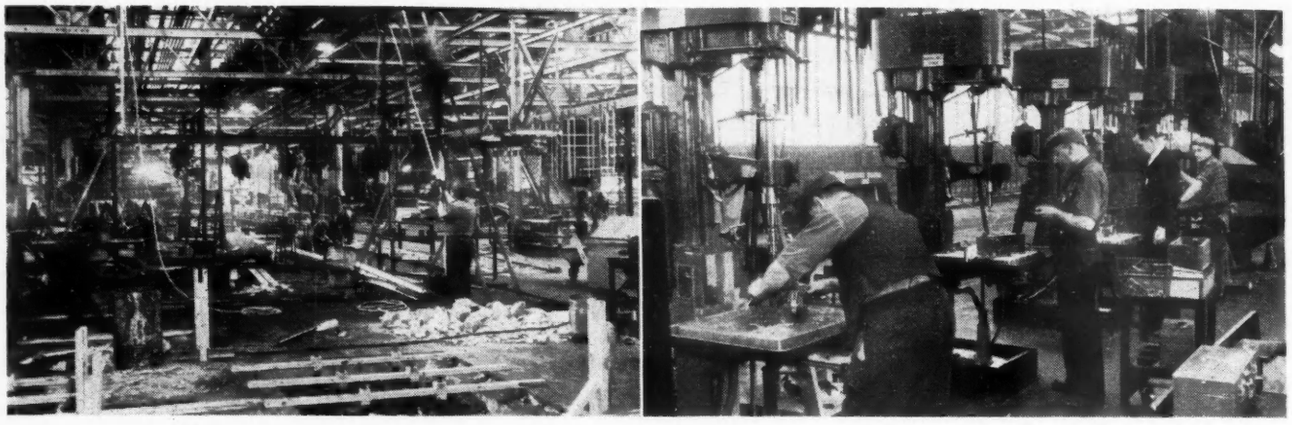
AEA Cancels Meet

The Automotive Electric Association has cancelled its manufacturers-distributors' conference and annual meeting scheduled for February 13-20, at Detroit.



Studebaker Military Trucks

As the result of quick conversion, Studebaker is swinging into increased production of military trucks. The photograph shows an engine being lowered into position on one of these vehicles nearing completion on the Studebaker line.



Chrysler's in a Hurry

The Chrysler Corp. is losing no time in conversion. All overhead conveyors, production lines, and other domestic car production machinery (left) must be moved at the Plymouth plant to make way for war production which is already under way (right) in some sections. In the background is the space formerly used for auto production.

Better Scrap Collection Methods Up Steel Output

War Production Board Tightens Control of Alloy Metals; Substitution and New Economies Ease Tin Supply Problem

by W. C. Hirsch

Recent developments at all ends of the metals supply problem indicate constructive progress toward the goal. Aside from the speeding up of scrap iron collections through the co-operation of consumers, the only step promising a measure of immediate relief from the continuing insufficiency of available steel-making material, sight is not being lost of the long-range cure of this shortcoming, which is, of course, the providing of additional pig iron furnace capacity. One of the large "independents," which has already under way the construction of four pig iron furnaces with a capacity of approximately 1,700,000 tons a year, has just announced the signing of a contract with the Defense Plant Corp. for the erection of a fifth furnace.

With war's inexorable demands making every additional pound of steel available thrice welcome at this time and for months, perhaps even years, to come, consideration of the effect of this expansion on the peacetime set-up of the steel industry appears to have been definitely shelved for "the duration." By the side of unceasing efforts to increase output, measures for conserving every pound of material that might be useful in defense products and essential civilian needs are being actively promoted. So the American Iron & Steel Institute announces sponsorship of four new types of alloy steels with properties corresponding to those obtained from the use of virgin chromium and nickel, but depending for their character on scrap that cannot be used in the construction of airplanes and armaments, and suitably heat-treated. The SAE and leading metallurgists have collaborated in this work.

In conformity with the supply situation in the various metals, regulations for the use of chromium and a number of other alloy metals have been tightened or otherwise amended by the WPB. Cobalt has been placed under full control. Not all of these intensify the restrictions imposed. So the diecasting industry advisory committee is reported to have been told that, if zinc and brass die castings function efficiently in the manufacture of artillery fuses, and tests bear this out, substitution of these for aluminum will be sanctioned. Extension of the supply of magnesium is promised through the construction of a plant with 36,000,000 pounds a year capacity in the South by one of the large alkali producers under an arrangement with the Defense Plant Corp.

A more hopeful outlook is taken regarding the supply of tin, this in spite of the war situation in the East Indies. Bolivia and other tin producing countries are expected to make up for a good part of what the East Indies will not be able to furnish. With consumption cut from more than 100,000 tons a year to between 50,000 and 60,000 tons, prospects are brighter.

The subject of price, long dormant, came to the fore when the Navy Department, seeking to obtain firm commitments on direct purchases of steel, was advised by OPA that it did not now forsee general changes in the price of steel mill products affecting deliveries during the second quarter of the year.

Material Control Plan

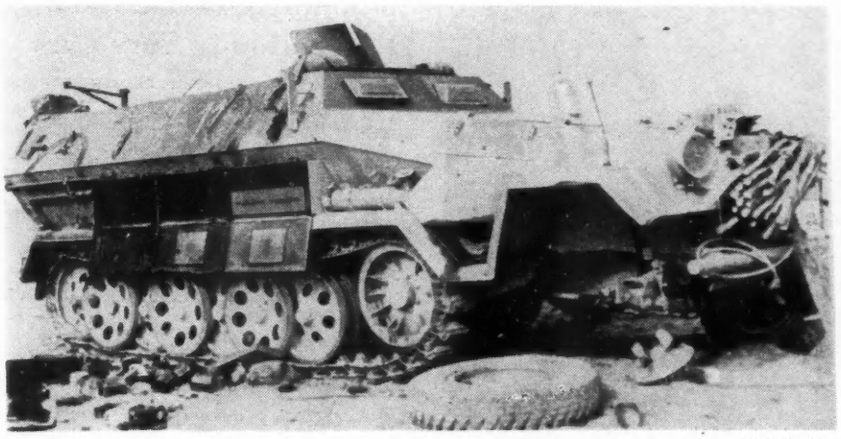
Henry Disston & Sons, Inc., of Philadelphia, is offering a Conservation Control Plan, of wide scope, designed to save vital materials and to speed up production. Based on "Conservation Control Cards," the individual worker is supplied with information essential to getting the maximum possible out of the tools with which he works. There are 35 of these cards, covering cutting tools for metal, wood, plastics, etc., including tool bits, files, hack saw blades, carboloy knives and cutters, circular metal and wood cutting saws, band saws for wood or metal, planer knives, etc.

The cards are supplied free to any plant, along with buttons bearing a seal and the slogan "Conservation Serves Everyone." In addition, there are posters prepared for the use of plants generally which "sell" the idea to the man as a means whereby their work will be made easier and better.

CALENDAR

Conventions and Meetings

Motor & Equipment Wholesalers Assoc., Atlantic City .....Feb. 23-28
American Society for Testing Materials, Cleveland .....March 2-5
Society of Automotive Engineers, Natl. Aeronautic Meeting, New York City, March 12-13
Amer. Society Mechanical Engineers, Spring Meeting, Houston, Texas, Mar. 23-25
American Society of Tool Engineers, St. Louis .....March 26-28
Natl. Petroleum Assoc., Cleveland, O., April 16-17
Midwest Power Conference, Chicago, April 9-10
American Foundrymen's Assoc. Annual Convention, Cleveland, O. ...April 20-24
Chamber of Commerce of U. S., Annual Meeting, Washington, D. C..April 27-30
Society of Automotive Engineers, Semi-Annual Meeting, White Sulphur Springs, W. Va. .....May 31-June 5
Natl. Metal Congress & Exposition, Detroit .....Oct. 12-17



British Combine

German Troop Carrier

During the Lybian campaign, this German troop carrier was put out of action by the British. Apparently, the front axle is supported by a transverse spring.

Unions Planning to Make Increased Demands

Requests for Wage Boost Based on Higher Living Costs; Many Contracts to Be Opened for Negotiation This Year

Demands for the union shop and a general $1-per-day wage increase will be pressed upon General Motors Corp. by the UAW-CIO when negotiations for renewal of the union contract are begun early in March. Those were the primary aims drafted by the National GM council of the UAW-CIO in a meeting at Detroit. However, the council turned down a proposal to ask GM for a dues checkoff, indicating that the Ford contract, negotiated last June following a ten-day strike and an NLRB election, is not working out to the satisfaction of Ford workers. Ford granted the union shop, checkoff, and wage increases.

The GM contract can be amended after April 28, but notice of such intention must be filed 60 days prior to that date. The wage demand probably will provoke widespread controversy, especially in view of government attempts to control inflation by putting a ceiling on prices. The GM contract usually sets a precedent for the industry. Last May a strike in GM plants was averted by referring the dispute to the National Defense Mediation Board, which finally approved a 10-cent-an-hour wage increase. Other automotive companies also were compelled to grant wage raises when their contracts expired. Among other contracts that will be opened for negotiation after the GM parley are Hudson, May 20; Chrysler, June 1; Ford, June 20; Packard, September 30, and Briggs, December 7.

The unions base their demands for pay increases on the rising cost of living. From May to December, 1941, the cost of living for wage earners in the U. S., according to the Dept. of Labor, increased 7.1 per cent. The GM raise of last May was approximately 10 per cent and the current $1-per-day demand approximates 11 per cent on the basis of current wages. Average weekly earnings of GM hourly rated men and women for November was $45.90, 40 per cent above the national average for all manufacturing industry. The average in all Michigan automobile plants for the same period was $44.65 per week on an average week of 36.8 hours.

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New Process Speeds Duplication of Drawings

To enable holders of government defense contracts to comply with the requirement that they file duplicate copies of the drawings of the parts being manufactured, The Frederick Post Co., Chicago, has developed a method of duplicating these drawings speedily by other than a hand-drawn process. The company's reproduction process conforms to government specifications.

Brakeblok Campaign Features a "Mutt"

The American Brakeblok Division of the American Brake Shoe and Foundry Co. has launched an extensive advertising and promotion program which will include four-color pages in national magazines along with an intensive dealer identification campaign. The campaign will be featured by the introduction of a new trade character, "Stopper," the mutt dog.

ACWP Extends Tool Listing Service

Extension of its machine tool and equipment service to include listing of all machine tools in the industry has been announced by the Automotive Council for War Production. Previously, the Council listing was restricted to machines not engaged in war work.

GM Employees Earnings Up

Wages paid to General Motors factory workers employed in the United States in 1941 reached an all-time high of $500,422.165. which represents an increase of $143,169,343, or 40 per cent over 1940.

Acme

Protesting Layoffs

Protesting against future layoffs in the automobile industry, these men are a part of the 3000 Fisher Body workers who formed a picket line and then marched to the lawn of the Michigan State Capitol to stage their demonstration

British Combine

Ramps for Loading Tanks

By means of the specially designed ramp shown in the photograph, a British tank is being driven onto a flatcar of the London, Midland & Scottish Railways.

MEN . . . . . .

James Dykstra, assistant chief engineer in charge of chassis and body engineering at Oldsmobile, has been appointed in charge of all car engineering and will assume added duties under the war production program. **V. G. Yallup,** formerly superintendent of experimental facilities in the car division, will serve in a similar capacity on war materials. **E. D. McLean** has been appointed gun standards engineer.

L. K. Marshall, service manager for Pontiac, has gone on active duty in the U. S. Navy as a lieutenant-commander. He has been succeeded by **V. L. Murray,** assistant general sales manager in charge of service.

Fruehauf Trailer Co. has named four new vice-presidents: **L. C. McAnly,** works manager, is now vice-president in charge of manufacturing; **John C. Votypka** is vice-president and director of production engineering, **F. M. Reid** is vice-president and director of experimental and research engineering, and **E. G. Grove** is vice-president and treasurer.

Richard S. Boutelle, general manager of the Fairchild Aircraft Division, has been elected a vice-president and director of Fairchild Engine & Airplane Corp., succeeding the late F. A. Galligan.

Lieut-Col. Harold E. Hartney has been appointed Washington technical consultant for Fleetwings, Inc.

I. Spencer Shore, on leave as vice-president and general manager of General Tire & Rubber Co., has been named chief of the Bureau of Industry Advisory Committees of the War Production Board, succeeding Sidney J. Weinberg.

R. Lawrence Vaniman, formerly executive manager of the African Division of Chrysler Corp., has been appointed deputy chief of the Automotive Branch, War Production Board, under Ernest C. Kanzler. Vaniman will maintain liaison between the WPB in Washington and the office of the Automotive Branch in Detroit.

Frank A. Stivers, formerly first vice-president of Hoover Ball Bearing Co., Ann Arbor, Mich., has been elevated to the presidency, succeeding the late Walter C. Mack.

Paul Fitzpatrick, director of policy and sales development for Motor Holding Division of General Motors Corp., has been named administrative vice-president of the American Arbitration Association.

James E. Wilson, formerly associated with Oakland and Reo and the Airtemp Division of Chrysler Corp., has been named Michigan manager of the priorities division of the War Production Board. He succeeds **Edmund H. Eitel,** acting manager, who has returned to his post as assistant manager of the Chicago priorities office.

Charles W. Baker, Jr., and **Thomas P. Durell** have been elected to the board of directors of Hayes Mfg. Co., Grand Rapids, Mich.

E. T. H. Hutchinson, sales manager of the automotive jobbing division of Sparks-Withington Co., has just completed 20 years of service with the company.

W. H. Schneider, formerly vice-president of the Toledo Trust Co., has been appointed comptroller of Willys-Overland Motors, Inc.

J. G. Green has been named assistant general manager of the storage battery division of Philco Corp.

Harmon S. Eberhard, chief engineer, has been elected a vice-president of Caterpillar Tractor Co. **Donald G. Sherwin,** vice-president, has been elected a director to succeed the late T. J. Connor.

H. Parker Thornton, comptroller, has been elected a vice-president of White Motor Co.

Nicholas S. Ludington has been elected a director of National Aviation Corp., succeeding Duncan H. Read, resigned.

Charles C. Tapscott, advertising manager for McQuay-Norris Mfg. Co., St. Louis, Mo., has been elected president of the American Highway Sign Assn. Other officers elected at the recent annual meeting of the association in Chicago were **W. S. Zehrung,** president of the Pennzoil Co., vice-president and **S. Messer,** president of the Quaker State Oil Refining Co., treasurer. This association has taken an active part in the protection of the rights of roadside property owners and outdoor advertisers.

Robert McCulloch has been made head of Vultee Aircraft Co.'s Nashville plant. He has been works manager there since last August.

W. F. Newbery has been promoted to Central Region Manager of Detroit Rex Products Co.

Major C. Robert Hoyme, formerly in charge of Mack bus sales in the midwest, has been transferred to the Pacific Coast Division. **John L. Wilson** succeeds him at Chicago.

A. G. Mulkey succeeds Herbert Wirshing as Pacific Coast Manager of the Waukesha Motor Co.

James R. Longwell, formerly Carboloy chief engineer, has been appointed to the newly created post of factory manager. **Paul H. Miller** succeeds Mr. Longwell.

Rationing Order Covers Distribution of New Cars

Automobiles ordered before Jan. 1, 1942, will be distributed by local rationing boards to properly certified persons by the end of February. Under Rationing Order No. 2 which covers the right to acquire passenger cars purchased but not delivered between July 1, 1941, and Jan. 1, 1942, purchasers are required to furnish proof that some payment has been made on the vehicle.

At present, some 645,000 new cars are in the hands of the nation's 44,000 dealers. Estimates of the number which can be released under the terms of the new order range from 15 to 25 per cent of the cars in stock. Federal authorities have undertaken distribution of questionnaires to car dealers to obtain accurate data of new cars on hand.

Army to Set Up Recapping Stations

To conserve rubber for military and essential civilian uses, the War Department will establish ten field shops capable of recapping well over 1 million tires annually for Army vehicles. Facilities also will be installed in the shops by the Quartermaster Corps to retread and repair several million additional tires each year. By giving immediate care to tire cuts and bruises, the shops are expected to save an estimated 75,000 tons of crude rubber a year.

Pledge No Work Stoppage

All machinists employed by the Acme Steel Co., Chicago, at the company's Archer Avenue plant have pledged their full support of the company during the war effort.

Lion Products Moves

Lion Products Co. announces the occuplation of new quarters, trebling their original floor capacity. Their new address is 242 Broad Street, Lynn, Mass.

Truck Production by Capacities

(U. S. and Canada)

	TWELVE MONTHS		
	Units		Per Cent of Total
	1941	1940	1941
1½ Tons and less	972,186	736,628	76.51
2 to 3 Tons	188,275	80,304	14.82
3½ Tons and over	29,516	17,312	2.32
Special and buses	38,126	22,300	3.00
Station Wagons	42,544	33,340	3.35
Total	1,270,647	889,884	100.00

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE AND AVIATION INDUSTRIES**

Business activity fluctuates narrowly from peak levels. The seasonally adjusted index of *The New York Times* for the final week of January stands at 139.4 per cent of the estimated normal, two fractional points below the record height reached in the preceding week, as against 122.7 for the corresponding period last year. The unadjusted index of *The Journal of Commerce* for the same period is 124.7 per cent of the 1927-29 average, as compared with 125.7 a week earlier and 116.3 a year ago.

The retail buying rush has subsided somewhat. Department store sales for the week ended Jan. 31, as reported by the Federal Reserve Board, were 29 per cent larger than in the similar period a year ago. Total sales for the four weeks ended on that date were 35 per cent above last year's comparable figure.

Railway freight loadings decreased slightly during the last week of January, totaling 815,567 cars, 2237 below the figure for the preceding week but 14.2 per cent above that a year ago.

Bank debits in leading centers during the thirteen weeks ended Jan. 28 were 19 per cent larger than in the corresponding period a year earlier. The increase outside New York City amounted to 23 per cent.

Electric power production during the week ended Jan. 31 advanced contra-seasonally and was 15.8 per cent larger than a year ago. This gain compares with one of 14.8 per cent a week earlier.

Cotton mill activity during the same period receded against the seasonal trend, the adjusted index of *The New York Times* falling to 171.4 per cent of the estimated normal from 177.3 for the week before, as compared with 150.8 a year ago.

Bituminous coal production in the final week of January averaged 1,817,000 tons daily, as against 1,833,000 tons for the preceding week and 1,692,000 tons for the corresponding period last year.

Contracts awarded for heavy construction during the week ended Feb. 5 fell 27 per cent below the preceding weekly figure, according to *Engineering News-Record;* but the 1942 total to date is 16.5 per cent above the corresponding amount last year.

Professor Fisher's index of wholesale commodity prices for the week ended Feb. 6 stands at 102.4 per cent of the 1926 average, as against 102.6 a week before.

Member bank reserves decreased $226 million during the week ended Feb. 4, mainly as the result of additions to money in circulation and Treasury deposits with the Federal Reserve banks.

New Blackout and Camouflage Paints

The Sherwin-Williams Co., Cleveland, Ohio, has developed a blackout paint which meets requirements of the Office of Civilian Defense and which is said to give excellent results in opacity, weather-resistance and non-reflective properties, when used on either the inside or outside of the glass. It is known as S-W Blackout Black.

Camouflage paints for concealing strategic military and civilian objectives by making them blend in with the colors of the surrounding earth and foliage to prevent spotting by aerial cameras and bombers, are also available from the company in such colors as field drab, earth brown, and dark green according to color standards established after testing by Army experts.

Stoughton Elects Officers

F. O. Phillips and Rolfe Hansen were re-elected directors of the Stoughton Body and Cab Co. at the recent annual meeting of the company. Holdover directors are M. H. Teige, president; Andrew Rein, vice-president; Henry F. Schumacher, treasurer; Duane Usher and O. O. Hoel. Mr. Hansen is secretary. Election of new officers was postponed to a later date.

Ford Ends Insurance Plan

Ford Motor Co. has terminated its group insurance plan for 125,000 employes, effective February 28. Local 600 of the UAW-CIO may take over details of the plan if arrangements can be worked out with the insurance company. Annual premiums paid by employes totaled nearly $3 million and were deducted from payrolls.

By-Products Adds Plant

A new one-story building estimated to cost $700,000 will be added to the facilities of the By-Products Steel Co.

Frank R. Schubert

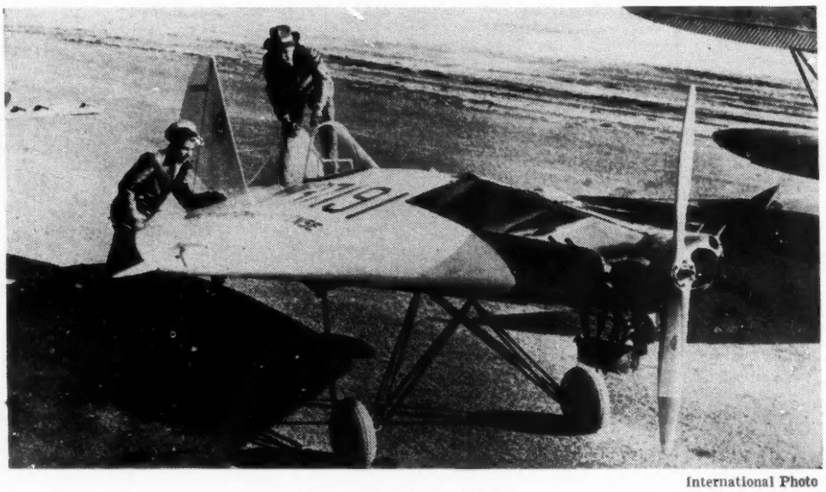
Frank R. Schubert, 47, assistant general manager of the Houde Engineering Corp. of Buffalo, died at his home there Feb. 4.

New Service for Seamless-Tube Buyers

The Seamless Steel Tube Institute, Pittsburgh, Pa., announces the establishment of a new service whereby purchasers may obtain information on the availability of various grades and sizes of seamless steel tubing for new or special wartime requirements.

New Passenger Car Registrations—Years 1941 and 1940

	December 1941	November 1941	December 1940	TWELVE MONTHS 1941	TWELVE MONTHS 1940	TWELVE MONTHS Per Cent Change	Per Cent of Total Twelve Months 1941	Per Cent of Total Twelve Months 1940	THREE MONTHS MODEL YEAR 1942	THREE MONTHS MODEL YEAR 1941	THREE MONTHS MODEL YEAR Per Cent Change
Chevrolet	35,160	35,794	88,195	880,346	853,529	+ 3.5	23.59	24.99	111,197	231,895	— 52.0
Ford	27,023	26,690	52,810	602,013	542,755	+ 11.0	16.14	15.90	78,383	142,983	— 45.2
Plymouth	19,875	17,187	37,621	452,187	440,093	+ 2.8	12.12	12.89	58,114	116,590	— 50.1
Buick	16,748	14,917	28,758	308,615	295,513	+ 4.7	8.27	8.65	42,253	88,992	— 52.5
Pontiac	14,661	13,338	25,143	286,123	235,815	+ 21.5	7.67	6.90	40,053	71,536	— 44.0
Oldsmobile	11,460	10,980	21,740	230,367	201,256	+ 14.4	6.17	5.89	30,272	60,254	— 49.8
Dodge	10,590	9,647	17,584	215,563	197,252	+ 9.0	5.78	5.77	30,692	43,642	— 29.6
Chrysler	5,559	5,458	11,421	143,025	100,117	+ 43.0	3.83	2.93	16,929	27,609	— 38.6
Studebaker	7,067	5,696	8,747	114,331	102,281	+ 12.0	3.07	3.00	18,957	26,917	— 29.5
De Soto	3,864	3,898	6,997	91,004	71,943	+ 26.8	2.44	2.11	12,748	17,919	— 31.6
Mercury	4,388	4,435	7,840	81,874	80,418	+ 2.0	2.19	2.35	12,218	19,595	— 37.6
Nash	3,619	3,215	6,164	77,824	52,853	+ 47.3	2.09	1.55	10,232	13,125	— 22.0
Hudson	3,895	3,152	6,227	73,261	79,979	— 8.5	1.96	2.34	11,196	20,329	— 45.0
Packard	4,624	4,773	5,678	69,653	73,794	— 5.5	1.87	2.16	15,479	18,537	— 16.5
Cadillac	3,286	3,545	5,360	60,242	38,564	+ 56.5	1.62	1.13	9,559	13,879	— 31.1
Willys-Americar	962	733	1,645	22,102	21,418	+ 3.1	.59	.63	2,830	4,846	— 31.5
Lincoln	1,254	1,098	1,817	18,769	21,004	— 10.7	.50	.61	3,321	5,463	— 39.3
Crosley	122	72	32	1,146	428	+167.5	.03	.01	330	111	+197.0
Graham	5	8	150	544	1,856	— 70.7	.01	.05	25	531	— 95.2
Bantam	3	4	26	138	791	— 82.5		.02	12	99	— 88.0
Miscellaneous	23	107	118	2,039	4,246	— 52.0	.06	.12	156	1,146	— 86.5
Total	174,188	164,747	334,073	3,731,166	3,415,905	+ 9.2	100.00	100.00	504,420	925,998	— 45.6
Chrysler Corp.	39,888	36,190	73,623	901,779	809,405	+ 11.5	24.17	23.70	117,947	205,760	— 42.5
Ford Motor Co.	32,665	78,574	62,467	702,656	644,177	+ 9.0	18.83	18.86	140,273	169,041	— 16.5
General Motors Corp.	81,315	32,223	169,196	1,765,693	1,624,677	+ 8.6	47.32	47.56	186,983	466,556	— 60.0
All Others	20,320	17,760	28,787	361,038	337,646	+ 7.0	9.68	9.88	59,217	85,641	— 30.8



International Photo

New Flying Wing

The Eshelman flying wing is shown during ground tests which are being made prior to the first experimental flight. If tests prove successful, the designer plans to build a larger model to be offered to the Navy as a carrier-borne fighter.

Moulder Appointed to WPB Committee

P. V. Moulder, Chicago, vice-president of the International Harvester Co., has been added to WPB's Automotive Industry Advisory Committee.

Dealer Tools Survey

Willys-Overland Motors reports that first returns from a nationwide survey of more than 5000 dealers to determine how dealers can share in the war effort reveal a sizable quality of tools which might be used for arms production.

Plomb Expands

Now nearing completion, another addition to the Los Angeles factory of the Plomb Tool Co. will aid in a scheduled production in 1942 over four times that of 1940, according to company officials.

Geschelin to Speak

Joseph Geschelin, Detroit Technical Editor, AUTOMOTIVE *and* AVIATION INDUSTRIES, will discuss future cars before the SAE, Dayton Section, on March 2.

Walter Davidson

Walter Davidson, 65, president and general manager of the Harley-Davidson Motor Co., died Feb. 7.

ADVERTISING

Ralph C. Champlin, formerly associated with Batten, Barton, Durstine & Osborn, has been named advertising director of Ethyl Gasoline Corp., succeeding **Paul E. McElroy,** who has entered government service.

E. W. Frank, formerly chief of the production department of Lord & Thomas, has been named production manager of MacFarland, Aveyard & Co.

PUBLICATIONS

Dole Refrigerating Co.'s catalog No. 22, describes **Dole Vacuum Cold Plates** and illustrates their various uses.*

Four publications by the Drever Co. are as follows: Booklet No. B-3 on **Industrial Furnaces;** B-4 on **Equipment for bright annealing stainless steels;** B-5 on **Ammonia dissociation equipment,** and a folder entitled, **The Drever-industrial process for surface hardening stainless metals.***

General Box Co.'s 12-page booklet, General Box, gives facts on more efficient **packaging.** It is illustrated and the story is written in a concise and interesting way.*

A 32-page catalog, No. 80, has just been issued by the Eclipse Air Brush Co., covering its complete line of **spray equipment** for manual and automatic operation, in addition to Pneumix air-motored agitators for all mixing jobs in batches up to 200 gallons.*

Hydraulic Controls, Inc., has published a new booklet describing and illustrating the Hycon line of **hydraulic controls.***

A new booklet by Laminated Shim Co., Inc., covers the history of the development of the industrial and mechanical applications of the **laminated shim.** It describes the use of this type of shim for the fitting of machine parts in the original assembly as well as for making service adjustments.*

A Primer on Grinding Wheel Safety, a brief presentation of important facts for the operator, has just been published by Norton Co.*

A new catalog, No. 15, by Whitney Metal Tool Co., gives complete information, prices, etc., on Whitney-Jensen **ball bearing punches, shears, angle iron machine, etc.***

The British Rubber Publicity Assoc., London, has published a chart, **Rubber data for the Engineer.***

A new circular describing its **Straight-Line Gear Generator,** particularly adapted to the cutting of spur and helical fine-pitch gears, has just been issued by The Fellows Gear Shaper Co.*

A new catalog-handbook by Ideal Commutator Dresser Co. gives a quick index source of reference for data on **Ideal Variable Speed Pulleys, Speed Transmissions, Automatic Tension Control Motor Base, etc.***

Technical Information on **Worthite,** an improved and useful acid-resisting alloy steel for the chemical and process industries, is contained in a new bulletin just issued by Worthington Pump and Machinery Corp.*

A new general catalog and price list has been issued by Vascoloy-Ramet Corp., covering its line of **tantalum-tungsten carbide tools and blanks.***

Bakelite Sealing Solutions for Porous Castings is the title of a new 4-page folder issued by Bakelite Corp., Unit of Union Carbide and Carbon Corp., which explains the use of these solutions for reclaiming metal and alloy pressure castings and contains instructions for impregnation of castings and baking operations.*

The new **South Bend No. 2-H Turret Lathe** is described in Bulletin No. 67-T, recently announced by South Bend Lathe Works.*

Subcontracting For Defense — A Study Prepared in the Interest of Stabilizing Employment, is the title of a report just issued by the Policyholders Service Bureau of the Metropolitan Life Insurance Co., 1 Madison Ave., New York City.

Precision Tube Co. has just released a new bulletin, No. 201, which gives complete mechanical and electrical specifications of **Packard Electric** Wire to specification AN-J-C-48 and 95-27-74. Also included are capacities and power factors of **Metal Shielded Wire** at various frequencies.*

Over 1000 Million Rings, title of a new booklet by Muskegon Piston Ring Co. tells in text and pictures the story of Muskegon's experience in piston ring manufacture.*

Mattick Printing Co. has issued three catalog sections covering its **Standard Forms—Aids to Better Management,** including bookkeeping forms, social security records, pay roll systems, etc.*

Jessop Lion Extra Carbon Tool Steel is described in bulletin No. 941 issued by the Jessop Steel Co.*

A four-page illustrated circular describing the new **American-Heanium Long Lyfe Abrasive Blast Nozzle,** has just been published by American Foundry Equipment Co.*

Band and Block rubber tracks for vehicles are described and illustrated in a new 8-page booklet published by The B. F. Goodrich Co. Savings in power, decreased rolling resistance and resistance to wear are among the subjects discussed. Data tables are also included.*

The New Jersey Zinc Co.'s folder **Zinc In War** contains some useful and interesting information regarding the use of zinc in many defense operations.*

Die List No. 18 of **Compo Oil-Retaining Porous Bronze Bearings,** listing a wide range of sizes in sleeve type and flanged bearings and thrust washers, has just been released by Bound Brook Oil-Less Bearing Co.*

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* Obtainable through editorial department. AUTOMOTIVE and AVIATION INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

New Birdsboro Plant

A building construction expansion program involving more than $1,000,000 is to be undertaken by the Birdsboro Steel Foundry and Machine Co. at its Birdsboro, Pa., plant.

Welding Film

Designed to speed up defense training, a new all-color film entitled "Inside of Arc Welding," has been produced by R. G. Wolff of Hollywood in collaboration with James F. Lincoln, president of the Lincoln Electric Co.

Chrysler, GM Plan New War Plants

(*Continued from page* 45)

retired in 1933 after 21 years in the automotive industry.

Klann, who will serve in the production department, was with Ford for 20 years, starting in 1908, and at one time was general superintendent of the Highland Park plant. Following that he was associated with Murray Corp., Cadillac and Hudson and since 1940 has been with the Federal Security Administration as regional shop supervisor. Brandt will be technical consultant on machine tools and equipment, in which he served for OPM. He has had 37 years' experience with Westinghouse. Hartner left the Ford Motor Co. in 1929 after 25 years with the company in engineering capacities. After several years as a consultant to the Soviet Government on new plant developments, he retired in 1932. Flanders was employed in an engineering and executive capacity by Continental, White, Muskegon Motor Specialties, and Houdaille-Hershey Corp., being executive vice-president and general manager of the latter firm when he retired in 1934 because of illness.

General Motors and Ford, are preparing to join Chrysler in the government's tank building program, and help fulfill President Roosevelt's aim of 45,000 tanks in 1942. The Fisher Body Division of GM at Flint expects to occupy its new final assembly plant for tanks by June 1. The plant is under construction at Grand Blanc, Mich., south of Flint. Meanwhile, sections of the huge Fisher Body No. 1 Plant at Flint, largest automobile body plant in the world, which was turning out 1000 Buick bodies a day up to February 4, is being cleared of presses, welding machines, and conveyor lines to make way for manufacture of tank parts.

The GM and Ford tanks both will be all-welded models of the new M-4 medium 30-ton tank in contrast to the present riveted M-3 28-ton type. Chrysler will change over to the M-4 during the summer. Fisher Body already has completed an all-welded hull as a pilot model, experimenting with new welding techniques and with new types of jigs to hold the armor-plate sections while they are being welded. The latter are adaptations from automobile body building practices. All machining of tank parts will be done at Fisher Body No. 1. The body assembly building has been cleared out for manufacture of ring gears, while the turrets also will be machined in this plant.

The Buick Division at Flint will assemble and machine transmission and final drive units for these tanks. Factory No. 2, formerly devoted to new car warehousing and shipping, and the axle factory will be converted to this production. Buick will employ 7000 men on tank manufacture. The new final assembly plant at Grand Blanc will employ 10,000. GM also is preparing to build the new M-1 60-ton tank at both Fisher Body and Buick. The GM tanks probably will be powered by diesel engines.

Both Fisher Body and Ford are conducting welding schools to have enough skilled labor on hand when manufacturing starts. One thousand men will be trained in the Fisher welding classes at Flint, which are being held at Flint Central High School, GM Institute and at Fisher Body No. 1.

Ford is rearranging the Highland Park plant for final assembly on tanks which is expected to begin in July. Many of the parts will be machined at the Rouge plant. Either an air-cooled or a liquid-cooled engine probably will be used to power the Ford-built tanks.

Passenger Car and Truck Production

(U. S. and Canada)

	December 1941	November 1941	December 1940	TWELVE MONTHS 1941	TWELVE MONTHS 1940	Per Cent Change
Passenger Car Production:						
United States plants	174,962	256,101	396,531	3,744,300	3,692,328	+ 1.6
Canadian plants	6,651	7,003	11,653	94,045	110,126	−14.5
Total	181,613	263,104	408,184	3,838,345	3,802,454	+ 0.9
Truck Production:						
United States plants	107,243	96,246	87,036	1,094,261	777,026	+41.0
Canadian plants	13,662	14,542	11,711	176,386	112,858	+56.4
Total	120,905	110,788	98,747	1,270,647	889,884	+43.0
Total—United States plants	282,205	352,347	483,567	4,838,561	4,469,354	+ 8.1
Total—Canadian plants	20,313	21,545	23,364	270,431	222,984	+21.1
Total—Cars and Trucks—U. S. and Canada	302,518	373,892	506,931	5,108,992	4,692,338	+ 9.0

Monthly Motor Vehicle Production

(U. S. and Canada)

	PASSENGER CARS 1941	PASSENGER CARS 1940	TRUCKS 1941	TRUCKS 1940	TOTAL MOTOR VEHICLES 1941	TOTAL MOTOR VEHICLES 1940
January	423,223	375,476	100,850	74,016	524,073	449,492
February	405,160	350,535	104,172	71,690	509,332	422,225
March	422,289	364,947	111,589	75,285	533,878	440,232
April	387,070	375,626	102,786	76,807	489,856	452,433
May	427,538	338,353	117,617	74,139	545,355	412,492
June	427,521	294,779	118,757	67,787	546,278	362,566
July	347,597	172,166	121,300	74,005	468,897	246,171
August	81,689	48,333	83,104	41,533	164,793	89,866
September	170,338	227,880	78,413	56,703	248,751	284,583
October	301,203	428,270	100,166	86,104	401,369	514,374
November	263,104	417,905	110,788	93,068	373,892	510,973
December	181,613	408,184	120,905	98,747	302,518	506,931
Total	3,838,345	3,802,454	1,270,647	889,884	5,108,992	4,692,338

Armed Forces Adopt Rubber-Saving Plans

Approximately 43,000 long tons of rubber will be saved during the next two years as the result of an agreement by the Army, Navy, and Marine Corps to accept for non-combat uses automotive tires manufactured from a modified compound containing a percentage of reclaimed rubber considerably higher than is at present being used.

New Oakite Divisions

Oakite Products, Inc., New York, has created two new divisions: One, located in Hartford, Conn., will serve customers in New England; the other, in St. Louis, Mo., will aid customers in the Southwest.

Louis F. Fedders

Louis F. Fedders, president and treasurer of the Fedders Manufacturing Co., Inc. (radiator makers) for 22 years, died Feb. 4 in his home in Buffalo after a year's illness.

40 YEARS AGO

During the first few months I owned an automobile I did not pay much attention to lubrication. To be sure I filled the oil boxes on every trip, but any old oil answered, and so long as the wheels revolved I was pleased. Later, as knowledge grew, I investigated the oil matter, until I found that proper lubrication meant an addition to speed and power, of considerable moment when on a long, hard journey. I now use the best oils I can get, and see the gears are daubed with prepared graphite. Usually I personally apply the oil or else stand directly over the man who does the job. Plenty of oil, even though it drips along the road once in a while, gives spirit to a carriage.

From *The Horseless Age*, Feb. 12, 1902.

All-Out War Effort

(*Continued from page* 44)

Plymouth, Chrysler, and DeSoto plants will be used for making parts and sub-assemblies for anti-aircraft guns, tanks, ordnance and bomber airframes for which Chrysler is a major contractor and eventually for the production of aircraft engine parts to supply the huge new plant that is to be built at Chicago. The Dodge main plant, formerly producing Dodge passenger cars, will supply parts for the increased output of army vehicles planned by the Dodge Truck Division. Chrysler has 16 million sq. ft. of floor space in all its U. S. plants, of which 10 million sq. ft. is now in use and another 2,500,000 sq. ft. is available for war work. The remaining 3,500,000 sq. ft. is not adaptable due to low ceilings or immovable equipment.

General Motors is completely revamping its automotive facilities at Flint in the changeover to war items. Sections of the Buick plant, including the axle division, already are turning out parts for the Pratt & Whitney aircraft engines which Buick is building in its new plant at Melrose Park, Ill. Another former storage shed will house the manufacturing facilities for tank transmissions to go into the tanks which GM will assemble in a new plant now under construction at Flint. At Fisher Body No. 1, one of the largest body plants in the industry, costly presses, spray booths, and conveyors have been moved out to make way for producing tank sub-assemblies. One welding machine for passenger car bodies which required several years to design and perfect was in productive use only 40 days when it had to be removed due to the war changeover. However, Fisher Body's welding experience has made it possible for the division's engineers to design a machine for welding tank plates that will do the job in one-fifteenth of the time required by the old arc-welding method used in tank manufacture. The Chevrolet plant at Flint is making ready to produce armored vehicles for the army.

Cadillac has expanded its production of Allison aircraft engine parts as a major supplier to the Allison plant at Indianapolis, while other parts of the Detroit plant are being made ready for tank manufacture. Oldsmobile already is a big producer of shells and aircraft cannon, while Pontiac is turning out anti-aircraft guns. Pontiac was unable to utilize any of its automotive equipment for gun making. Chevrolet began last summer the conversion of an engine plant near Buffalo for making Pratt & Whitney aircraft engines. Ten Fisher Body plants are engaged in turning out sub-assemblies for medium bombers that are assembled at Kansas City, Kan.

Ford is making plant space available at the Rouge for producing tanks but about 50 per cent of the machinery required had to be ordered. Only about 15 per cent of Ford's automotive machinery was convertible to making four-engine bomber airframes, and only 10 per cent could be adapted to turning out Pratt & Whitney aircraft engines. Ford had to build new plants for both the latter projects. Some Ford assembly plants will be used for making army combat vehicles while the Highland Park plant will turn to tank manufacture.

Hudson is making Wright aircraft engine parts in former automotive space, while Packard is expanding its marine engine production in what was formerly the passenger car division. The entire facilities of Willys-Overland are engaged in war output on such items as army combat cars, shells, naval ordnance, and aircraft forgings.

Machine tools and toolrooms have been termed the current bottleneck in the war production program by Ernest C. Kanzler, chief of the Automotive Branch of the WPB. Helping lick this problem is the machine tool listing service of the Automotive Council for War Production. Already functioning in the AMA offices at Detroit, this service, under the direction of William J. Cronin, is undertaking to list and classify more than 350,000 machine tools in the automotive industry. These machine tools are owned by passenger car and truck manufacturers, parts and accessory suppliers, and tool and die shops. It is expected that this huge cataloging job will be completed by the end of February and that a majority of the 1500 companies circularized will have their facilities indexed. Employment of the Holderith punch card system will facilitate the rapid location of needed equipment for any producer of war material. The index will be available not only to members of the automotive industry but to any war contractor in the nation.

To locate some critically needed equipment whose lack is delaying the war program, Kanzler recently sent a telegraphic request for 25 types of multi-purpose machinery to all truck and passenger car manufacturers and to about 150 of the largest parts makers. This critical list of metal-working machines follows: horizontal boring machines, jig boring machines, vertical boring machines, chamfering machines, hobbing machines, deep hole drilling machines, radial drilling machines, turret lathes, gear grinding machines, internal grinding machines, toolroom lathes, thread milling machines, engine lathes (24-in. and up), milling machines, planers (36-in. and up), multiple spindle automatics, profiling machines, rifling machines, bar machines, rifle reaming machines and thread grinding machines.

Kanzler anticipates that outright sale of necessary machinery will be the most practical method of handling transactions between companies.

New Truck Registrations*

(U. S. and Canada)

	December 1941	November 1941	December 1940	TWELVE MONTHS 1941	TWELVE MONTHS 1940	TWELVE MONTHS Per Cent Change	Per Cent of Total Twelve Months 1941	Per Cent of Total Twelve Months 1940
Chevrolet	13,549	11,845	16,093	212,797	185,636	+ 14.9	33.22	33.20
Ford	11,446	11,247	14,525	174,024	159,514	+ 9.1	27.16	28.53
International	5,620	4,161	5,502	92,482	76,833	+ 20.4	14.43	13.74
Dodge	4,467	4,107	4,180	62,925	54,323	+ 16.0	9.82	9.72
G. M. C.	3,090	2,654	3,285	45,703	38,841	+ 17.9	7.13	6.94
Mack	493	468	630	9,468	7,736	+ 22.3	1.48	1.38
White	585	540	592	9,271	6,468	+ 43.5	1.45	1.16
Plymouth	78	99	767	7,732	9,528	− 19.0	1.21	1.70
Diamond T	389	325	406	6,077	6,354	− 4.2	.95	1.14
Studebaker	312	333	122	5,078	1,206	+321.0	.79	.22
Autocar	155	162	149	2,510	1,944	+ 29.0	.39	.35
Divco	96	194	162	2,306	1,662	+ 38.3	.36	.30
Brockway	143	162	135	2,294	1,672	+ 37.1	.36	.30
Willys-Americar	181	95	107	2,031	2,291	− 11.3	.32	.41
Federal	147	114	134	1,611	1,613		.25	.29
Reo	89	119	94	1,543	624	+147.4	.24	.11
Hudson	34	34	75	736	760	− 3.1	.11	.14
Sterling	26	16	28	400	341	+ 17.2	.06	.06
F. W. D.	15	27	15	280	252	+ 11.1	.04	.04
Bantam			4	40	335	− 88.2	.01	.06
Miscellaneous	91	97	157	1,389	1,217	+ 14.0	.22	.21
Total	41,006	36,799	47,162	640,697	559,150	+ 14.8	100.00	100.00

* Federal Government Deliveries are not included in these data.

Timely Title

Because of our involvement in the present war, A. Schrader's Son has changed the title of its poster addressed to motorists; originally entitled "Conserve Rubber for National Defense", it now reads "Conserve Rubber for Victory".

Automotive exhaust manifolds must have resistance to growth, and good strength at elevated temperatures. Competitive conditions demand minimum costs.

An iron containing about 3.30% C — 2.20% Si — 0.70% Mn — 0.60% Cr — and 0.60% Mo does the trick, while holding down foundry and machining costs.

This Chromium-Molybdenum combination is characterized by high strength and toughness at the working temperatures encountered in exhaust manifolds. Its growth resistance prevents warpage and cracking — saves gaskets.

Send for our free technical book, "Molybdenum in Cast Iron," giving detailed data on Molybdenum irons of interest to production engineers and executives.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTES FOR THE CUPOLA • FERROMOLYBDENUM FOR THE LADLE

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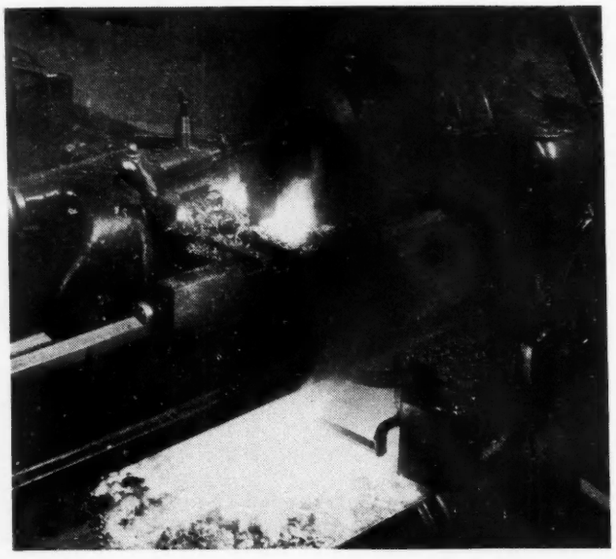


Magnesium Fires

Magnesium fires, which are often started by friction, are enough to baffle any fireman. Application of the usual methods of fire-fighting frequently causes explosions or spreading of the conflagration. Firemen at the Vega Aircraft Corp. have invented a new extinguisher which, it is said, will put out such a fire in less than a minute

Union Demands

(*Continued from page* 47)

GM factory payrolls in 1941 totaled $500,422,165 for an average annual wage of $2,256.62. Average weekly earnings of $43.40 were 14 per cent greater than in 1940.

Ford, Willys-Overland, and Murray Corp. are the only large automotive companies to grant the union shop in a contract.

Other union contract demands on GM are: Elimination of existing differentials in pay for similar work; pay increases to GM tool and die workers to bring them up to the level of independent jobbing shops; a $100 defense bond, costing GM $75, in lieu of the present vacation allowance of 40 hours' pay, averaging about $45; establishment of a shop steward system; revision of grievance handling machinery and of the apprenticeship plan; and extension of the powers of the impartial umpire.

The dispute between GM and the UAW-CIO over premium payments for weekend work when it comes within the 40-hour week was referred to the War Labor Board February 6, when the board agreed to hold hearings and reach a decision. Present contracts call for time and one-half for overtime and time in excess of eight hours per day or 40 hours per week; furthermore, the contracts allow double time for Sunday work. In order to speed war production and absorb the workers who have been laid off by cessation of passenger car manufacture, plants have arranged to put in the swing-shift arrangement in which four 40-hour shifts alternate working hours so that the week-end work comes only every four weeks. Seven GM plants were scheduled to go on a seven-day, 160-hour basis in February. If the WLB decides in favor of the union, GM will make the pay retroactive where the plan has been put in effect. The War Labor Board decision in the GM case is expected to set the precedent for other automotive and aircraft companies.

With the automobile industry now holding war contracts in excess of $11 billion, employment in many plants will double that of its previous peak some time in 1943. The three largest automotive companies, GM, Ford, and Chrysler, will have peak employment of 805,000 workers, it is estimated on the basis of present projections, a gain of 68 per cent over the 480,000 employes on the payrolls in June, 1941, the previous top. GM workers totaled 303,483 last June but the war peak will be 450,000. Employment on war production will climb to 148,000 in March, and in the next six months war workers will be added at the rate of 14,500 per month compared to 7,000 per month previously. Ford contemplates war employment of 225,000 workers in the Detroit area alone, with 100,000 at the new Willow Run bomber plant, 100,000 at the Rouge and 25,000 at Highland Park. Chrysler's payrolls will rise from last June's peak of 80,000 to an estimated 130,000 workers.

Retreads Rationed Under New Order

Rationing regulations on recapped and retreaded tires will be put in effect on Feb. 19, according to an announcement by Price Administrator Leon Henderson. A new WPB order limits the amount of crude rubber which may be used in the making of many essential rubber products.

Intended to save around 25,000 tons of rubber each year, the WPB order is expected to save 10,000 tons as the result of a reduction of approximately 15 per cent in the amount of rubber used in tires and tubes.

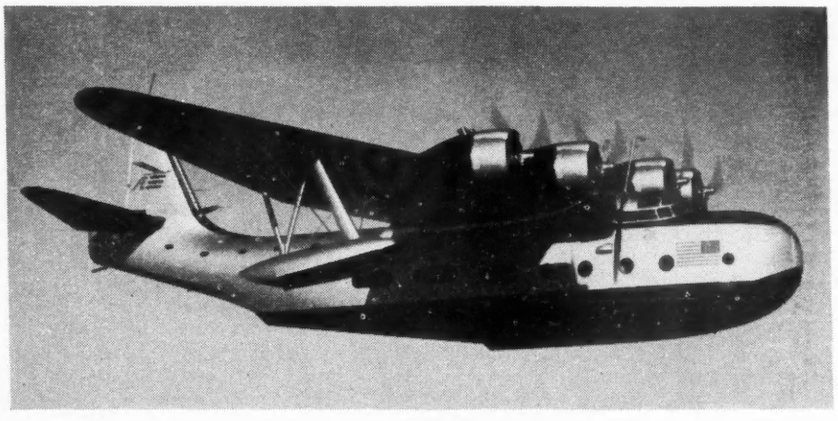
Two new eligibility lists have been created by Henderson's OPA. List A is about the same as it has been under the rationing plan for new tires. List B pertains to vehicles eligible to apply for certificates for retreaded or recapped tires. No list B vehicles will be able to obtain retreads until further notice. Certificates for truck types included in this list will be issued only during the closing days of each month, provided the needs of list A vehicles have been met.

Landis Builds Additions

The Landis Machine Co., Waynesboro, Pa., has completed two additions to its plant which will facilitate present operations and materially increase manufacturing capacity. One structure provides a convenient means of storing chips and cuttings. The other building, which adds approximately 25,000 sq. ft. of floor area, will house a new erecting floor and a shipping department. The company expects to use this additional space for the manufacture of the recently announced Landis Precision Thread Grinder.

A. N. Lindberg

A. N. Lindberg, president of The Lindberg Engineering Co., and The Lindberg Steel Treatment Co., Chicago, died on February 2.



Maiden Flight

The "Excalibur," giant four-engined monoplane just completed at the Vought-Sikorsky Aircraft division of the United Aircraft Corp. for the American Export Lines, takes to the skies in its maiden voyage. Powered by four Pratt & Whitney 1200-hp. engines, the "Excalibur" can accommodate 40 passengers and a crew of seven on trans-ocean flights. Sleeping capacity for 16 persons is provided.

It Stays Put!

Gasoline, in the tank or running through a pipe line to the carburetor . . . Lubricating Oil, slashing around in a crankcase or being pumped to all parts of a motor . . . Water, hot or cold, passing through a radiator into the motor block . . . none of these fluids will make a bead of Permatex Form-A-Gasket move from position, melt or dissolve!

All three types of Permatex Form-A-Gasket stay where they are put. They seal completely and permanently.

Form-A-Gasket Number 1 dries fast and sets hard.
Form-A-Gasket Number 2 dries slowly and remains pliable.
Aviation Form-A-Gasket sets quickly but does not dry.

PERMATEX COMPANY, INC.
Sheepshead Bay, N. Y., U. S. A.

Progress in Structural Design Through Strain Gage Technique

(*Continued from page* 37)

tions to some of the difficulties encountered in strain gage testing.

Limiting Factors of Overhaul Periods for Aircraft Engines

"THE limiting factor for the optimum overhaul period of aircraft engines may be an economic factor due to the inability to utilize all of the life of the various parts on which the initial cost write-off per hour is high. The limiting factor to the maximum overhaul period is concluded to be the volume of the crankpin centrifugal deposit and general lack of cleanliness of the engine. These factors can be alleviated by decreasing the tendency for the oil to form sludge, by decreasing the amount of lead in the lubricating system through improvement in ring sealing and fuel refining, and by providing effective filtering facilities in the lubricating systems.

Analysis of a Typical Sample of Crankpin Deposit

	Per Cent	Source
Soluble in ASTM Naphtha	8.01	Mineral oil present as such—from oil
Insoluble in ASTM Naphtha	.75	Gums and resins—from oil
Soluble in Chlorine		
Carbon and Carbonaceous Matter	2.97	From oil
Silica and Silicous Matter	1.09	Sand and dust contamination
Lead as PbO	69.41	From fuel
Iron as Fe_2O_3	3.39	From wearing parts
Halides as Bromine	15.6	From fuel
Specific Gravity at 80°F.		4.159
Weight in Ounces		12.5
Time Since Overhaul (Hours)		538

"Should these factors be successfully eliminated, the overhaul period would be expected to be limited at 1500 hr. by: (1) Pitting of the reduction gear teeth; (2) wear and failure of the master rod bearing; (3) ring wear and carbon deposits in the ring grooves, and (4) wear on the crankshaft main bearings."

These were the conclusions reached by Marvin Whitlock, powerplant engineer, American Airlines, Inc. By grouping the major portions of the engine, Mr. Whitlock described the kinds of wear found in each section. In conclusion, the author analyzed the probable causes of wear and made suggestions for improvement in design which would lead to longer runs between overhauls.

Light Plane Design Problems

THE problems of light plane design were handled in two papers, one by Walter E. Burnham, chief engineer, Freedman-Burnham Corp., and the other by Otto C. Koppen of the Massachusetts Institute of Technology.

In his paper dealing with the installation of controllable-pitch propellers on light planes, Mr. Burnham gave a synopsis of the theory supporting the use of this type of propeller. The author felt that development has been hampered by high initial cost, lack of maintenance facilities, weight and balance problems, and the variation in the design of engine shaft ends.

Mr. Koppen expressed his views concerning the future use of light planes. "The average light plane is not useful for trips of less than 150 miles; for shorter trips it is more convenient to go by automobile. Automobile experience shows that the average trip is less than nine miles. If for some reason the automobile were not practical for trips of less than 50 miles, it is doubtful if many would be used." In expanding his views the author concurred with Mr. Burnham in the belief that the development of practicable controllable-pitch propellers would make light planes far more useful.

Table showing comparison between performance characteristics of variable and fixed pitch propellers.

	Fixed Pitch	Variable Pitch
Design R.P.M.	2000 R.P.M.	1000 R.P.M.
Take-off R.P.M.	1825	1725
Gross Weight	1500 lb.	1650 lb.
Ground Drag	38 lb.	41 lb.
Air Drag	150 lb.	165 lb.
Thrust	460 lb.	840 lb.
Net Thrust	272 lb.	634 lb.
Take-off Speed	30 mph	30 mph
Take-off Run	171 feet	80 feet

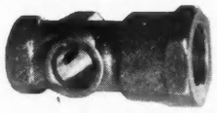
Summary of Overhaul Period Limits on Various Groups of Parts

SECTION	LIMIT OF OVERHAUL PERIOD (HRS.)	MOST IMPORTANT FACTORS THAT AFFECT THIS LIMIT: DUE TO	Fatigue	Wear	Lubrication	Deposits	Burning
1. Nose section, crankcase blower and rear cover	3000	Fatigue of rear cover and deposits in oil passages	X			X	
2. Propeller shaft and reduction gear	1500	Pitting of teeth on stationary and reduction gear	X			X	
3. Crankshaft	1000	Crankpin deposits		X		X	
4. Master rod and link rods	1500	Wear and failure of bearing		X	X		
5. Cylinders and Valves	3000	Cylinder barrel wear and burning of valves		X	X		X
6. Pistons and rings	1500	Ring wear and carbon deposits		X	X	X	
7. Cam and cam train	3000	Condition of cam surface	X			X	
8. Accessory drives	6000	Bushing wear and gear tooth failure	X	X			
9. Bearings (Anti-friction)	1500	Pitting of crankshaft main bearings	X		X		
10. Oil pump	8000	Gear and housing wear	X	X			
11. Oil pump relief valves	Periodic	Accumulation of deposits			X	X	
12. Oil strainer	Periodic	Accumulation of sludge and deposits			X	X	

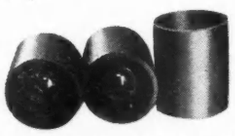
The SUNNEN PRECISION HONING MACHINE
is Helping to Speed Up DEFENSE PRODUCTION by Handling Jobs Like These FASTER, More ACCURATELY

Drawing and Blanking Die "Saves time in producing smooth base metal finish."

Inner Bearing Ring "Accurately removes last 'tenth' of stock."



Bronze Valve. The Sunnen method of honing is used to secure a high finish and accuracy.

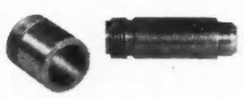


Molded Composition (Bakelite) Pulleys. Molded composition is a difficult material to machine but it can be easily honed to a smooth finish.

Stone Lettering Air Hammer "Sunnen honing does in five minutes what it took 20 minutes to do by lapping."

"Produced an extremely accurate and glass-like finish."

Diesel Engine Fuel Injector Cylinder "So accurate that a piston can be fit within .00005 inch."



Bushings for Automatic Drinking Fountain "Saves buying new expensive production equipment."

Drill Jig Bushing "Increases sales appeal of product."

"Strict alignment maintained between two holes."

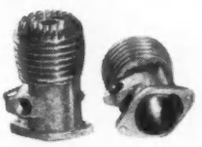
Aviation Hydraulic Cylinder made of Aluminum-Alloy. Improves the quality of the bearing surface. An extremely smooth surface-finish is secured.

Honing was used to correct errors of previous machining operations and to obtain a highly-polished surface finish.

Hardened Steel Parts. Honing is used to remove burrs caused by the flash of a punch press operation.

Mild Steel Clevis. Honing was used to correct errors of previous machining and maintain true alignment of the two bearing surfaces of this clevis.

Hardened Steel Gears. Honing used to remove any distortion after hardening and to selectively size the gears to uniform diameters.



Miniature Model Airplane Cylinders "Eliminates expensive machine set-up."

Taper removed at a rate of 80-90 per hour from automobile distributor shaft gears.

Better finish and alignment maintained on yoke for compressor

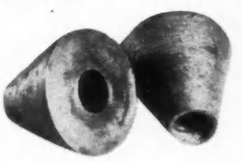
Aluminum Aircraft Link "produces high finish without bell-mouthing"

Hardened Steel Inner Bearing Race honed to .00005" limit. Surface finish improved; errors of out-of-roundness eliminated.

Aircraft Valve Tappet Roller. 4-Micro finish.

Hardened Steel Ring Gauge—finished to an accuracy of .000025" for roundness and straightness

Compressor roller "maintains .00005" limits; increased production over 100%.



Cones for Wheel Balancing Machine "Accurately align hones two interrupted surfaces."

Sunnen honing corrected distortion caused by hardening for manufacturer of small parts.

Crankshaft Grinder Bracket "Replaces expensive machine set-up for short-run production."

Airplane Engine Parts accurately honed to a super-smooth finish.

Saved time in producing a smooth accurate finish on this bronze remote control valve body

Grinds and finishes internal cylindrical surfaces from .185" to 2.400" with guaranteed accuracy of .0001". Relieves big internal grinders. Does not require skilled labor! Can be set up in less than a minute. Is saving money, increasing production and improving quality for hundreds of manufacturers handling important defense orders.

SUNNEN

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7915 Manchester Ave., St. Louis. Detroit Office: 321 N. Lafayette Blvd.
Canadian Factory: Chatham, Ontario

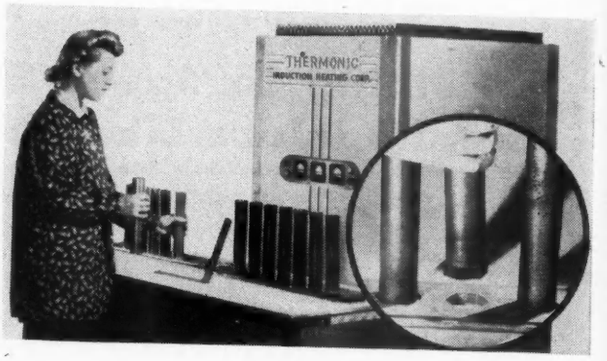
Write for FREE 8-Page Bulletin

giving complete information or, if you prefer, a Sales Engineer will be glad to call with his demonstrator and show you what this machine can do on your job.

MEN and MACHINES

(*Continued from page* 43)

CAPABLE of brazing 10,000 4-lb. units per day, a new Thermonic brazing machine, built by the Induction Heating Corp., New York, N. Y., handles seven pieces at one time. Operation is completely automatic; no adjustments are necessary after preliminary settings are made.



This new Thermonic automatic brazing unit is manufactured by the Induction Heating Corp., New York, N. Y.

ON THE COUNTRY'S ACTIVE SERVICE

HONOR ROLL

HANSEN Push-Tite
AIR HOSE COUPLINGS

SPEED, EFFICIENCY and ECONOMY is the order of the day in all industrial and aviation plants handling Army, Navy and Aviation jobs. Hansen Push-Tite air hose couplings have been called for active duty in hundreds of these plants because they are the most dependable, efficient and easiest to operate air hose coupling on the market. To connect a Hansen Push-Tite air hose coupling merely give the plug a slight push into socket, it is connected and the air is automatically turned on. An easy pull back on sleeve and it is disconnected instantly and air is automatically shut off.

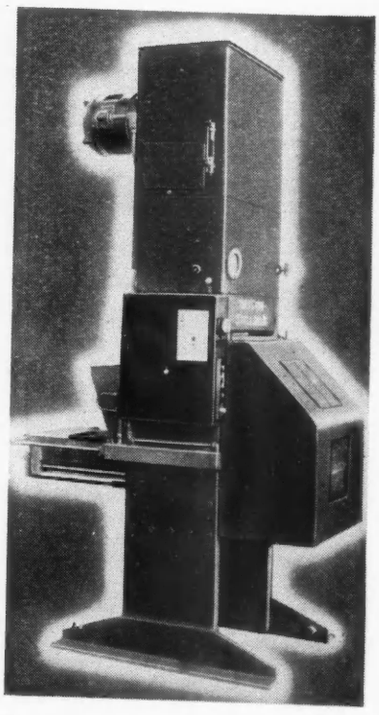
Hansen Push-Tite air hose couplings are absolutely air tight at all pressures, no leakage at any time. There is no twisting or turning of parts in order to connect or disconnect and no kinking or twisting of hose due to complete swivel action of coupling.

Write for free catalog

Hansen MANUFACTURING CO.
1786 E. 27th STREET • CLEVELAND, OHIO
Manufacturers of Industrial Air Line Equipment

AN IMPROVED 75-ton, fully automatic compression molding machine, developed by the Watson-Stillman Co., Roselle, N. J., is said to afford faster molding of plastic products than previous machines of this type. All setting for time, periods, materials, quantities, and pressures can be made from a single control panel.

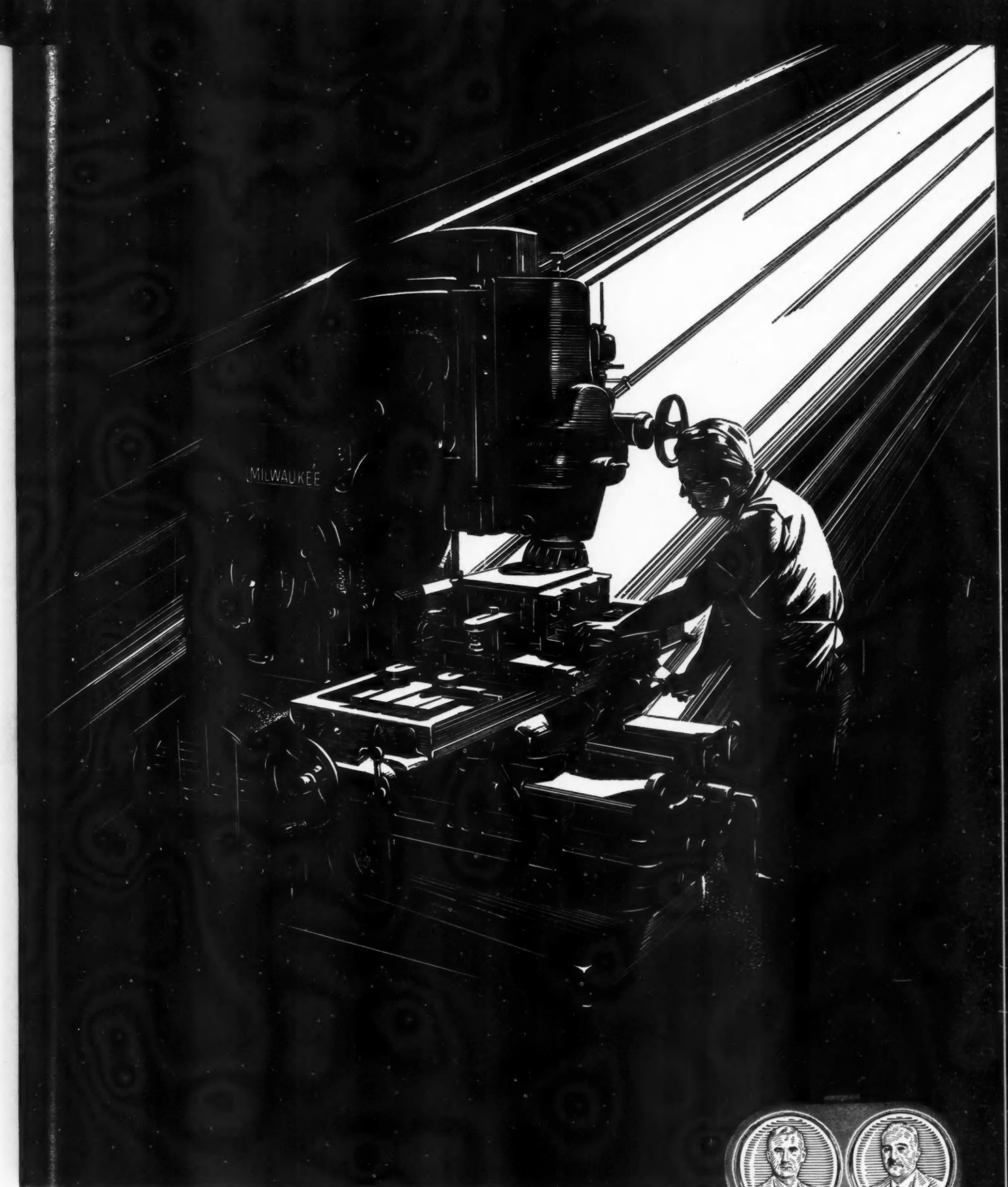
With a 10-in. stroke, the unit has an approach speed of 210 in. per min., a pressing speed of 3.3, and a return speed of 140 in. per min. Die space is



This new 75-ton, fully automatic compression molding machine, built by The Watson-Stillman Co., affords faster operation and greater ease of adjustment.

18 by 18 in.; maximum height of each die half is 8 in. Operated by a 5-hp. pump, the machine has bottom and top ejectors, and is suitable for all materials adapted to compression molding.

Other models in capacities of 25, 50, and 100 tons are available.



Milwaukee Model K Vertical Milling Machine

Tools That Put More Production Minutes Into the Hour.

KEARNEY & TRECKER CORP., MILWAUKEE, WIS., U. S. A.

KEARNEY & TRECKER
CORPORATION
Milwaukee
MILLING MACHINES

Milwaukee MILLING MACHINES

Tenth Annual Meeting of the Institute of the Aeronautical Sciences

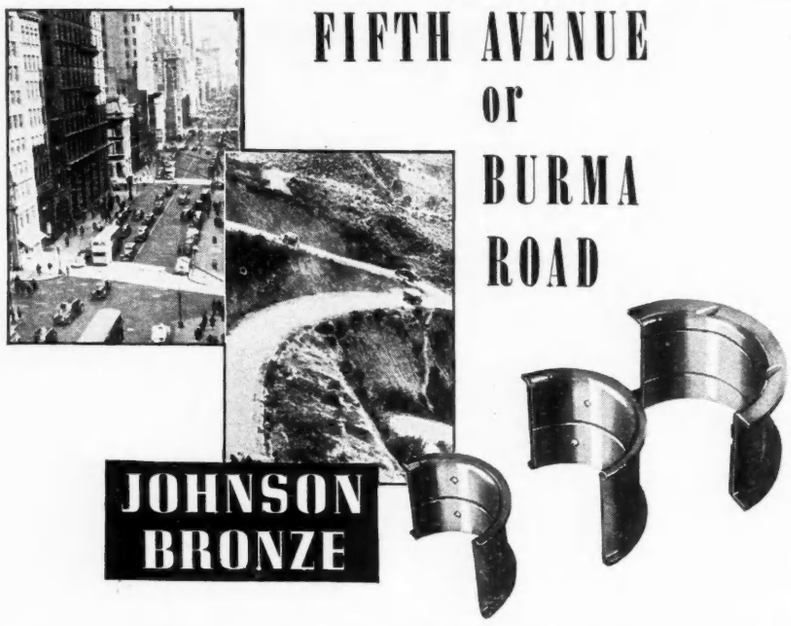
(*Continued from page* 29)

which volume of production of such planes can be stepped up. Flash butt welding of chrome molybdenum steel, torch welding control procedure and the X-ray of aircraft castings were among the other subjects.

At the session on rotating wing aircraft, considerable interest was shown in Igor I. Sikorsky's discussion of the recent developments and flights of his VS-300 helicopter. Rotor bending moments in the plane of flapping were analyzed by Alexander Klemin, of New York University, and rotor blade design problems by Richard H. Prewitt, of Kellet Autogiro Corp. Montgomery Knight, Georgia Institute of Technology, presented the paper, "General Flight Analysis of the Helicopter."

Results of physiologic research pertaining to pilots during flight, especially at high altitudes, were given by experts from Army, Navy and medical institutions. Included were the physiologic aspects of the free-fall parachute jump of 30,800 ft., which was made by Arthur H. Starnes in 1941.

Papers on meterology, aerodynamics and air transport were read during the sessions of the final day. In predicting rates of climb, Frederick C. Phillips, of the Glenn L. Martin Co., recommended that in calculations for higher operating altitudes and higher loadings allowance should be made for the error incurred by assumption of zero acceleration along the flight path. Lee Arnold, of the Pratt & Whitney Aircraft Division of United Aircraft, in his paper, "A Vector Solution of the Three Degree Case of Wing Bending, Wing Torsion and Aileron Flutter," developed a new method for the determination of critical flutter speeds and frequencies. The advantage claimed for this method is that their determination can be made in five to eight man-hours as compared to 30 or 40 man-hours by the usual method.



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Deliver the Goods

♦ The stop and go traffic of Fifth Avenue . . . or the gruelling service of the Burma Road are all part of a days work for JOHNSON Bearings. An extra measure of quality found in every Johnson Bronze product enables them to meet all types of operating conditions.

When you place your bearing requirements with Johnson Bronze, you gain the advantage of modern manufacturing methods . . . skilled men . . . and over thirty years of bearing experience. Regardless of your application we can help you secure greater performance and longer life, usually at a lower cost. Why not write today?

JOHNSON BRONZE

Sleeve BEARING HEADQUARTERS

625 S. MILL STREET NEW CASTLE, PA.

Keeping the Record Straight

(*Continued from page* 19)

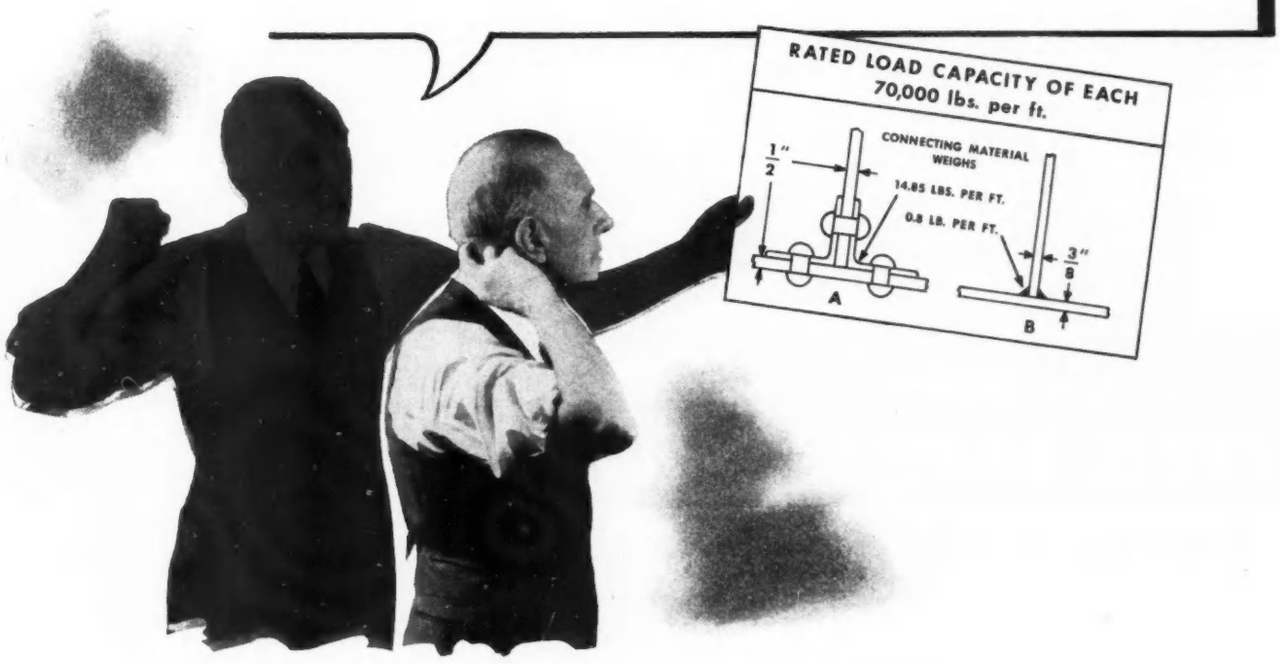
powerful machine can provide the rigidity that is needed to remove metal within the fine tolerances and fine surface finishes so essential in airplane parts.

A further complication is that airplane parts must be hewn from relatively large masses of metal in order to develop the desired physical properties. For example, a part that weighs, say, 50 lb. when finished, usually has been whittled down from a forging weighing at least 250 lb. Generally speaking, airplane engine forgings range from three to five times the weight of the finished parts. And that implies a tremendous amount of metal removal.

Attempts have been made to generalize on the extent to which existing facilities can be converted to the production of the weapons of war. Actually it is impossible to generalize. If a passenger car transmission plant is converted to the making of truck transmissions, the conversion is likely to be of a high order of utilization. If a passenger car axle plant is turned to the production of truck or bus axles, the same is likely to be true. But if it were necessary to build machine gun parts in an axle plant or in a transmission plant, the ratio of conversion would be quite low. Just a few weeks ago, Harry J. Klingler, speaking before the Pontiac Rotary Club, made the statement that none of the machinery in the Pontiac automobile plant could be utilized in the expansion of facilities for making Oerlikon anti-aircraft guns.

In the final analysis, what is needed in these critical times is a clear understanding of the problems confronting the country, and their execution by trained men of honest purpose. Despite the welter of confusion, the skilled production men of the automotive industry will do the job and will get it out in the quickest possible time.

then I said to myself—



This looks like . . .
MORE FOR LESS

We've been more or less successful in our methods—but let's assume we're wrong. Let's get a fresh start and prove each step as right before we take it.

ALTER EGO: Fine exercise to prevent manufacturing ruts. Let's start with the two ways of joining two plates at right angle, say. What's the procedure for method "A"?

It's plain to see we hold the plates with angles and rivets. We must drill or punch holes, fit them up, fill them up with rivets and hammer down the heads of the rivets. This requires 14.85 pounds of connecting material per foot of joint.

ALTER EGO: And in method "B" you just weld a bead along each side of the joint. This joint requires only 8/10 of a pound of connecting material per foot. But look closer, what else do you find?

Here's the big point. To get a load capacity of 70,000 pounds per foot, in the case of "A" we must use ½-inch plate—while in "B" we can use only ⅜-inch plate!

ALTER EGO: Isn't it obvious then that welding gives MORE for LESS. Now, how can we get that for our present work and future plans?

A good starter would be to invest $1.50 in that Procedure Handbook which is published by The Lincoln Electric Company, Cleveland, Ohio, and study it so that we can figure out how arc welding can give us MORE for LESS.

ALTER EGO: Literally, "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

Aircraft Gear Production

(*Continued from page* 27)

per cent check on the Magnaflux machine.

All spur gears are tested 100 per cent on the Red Ring gear speeders primarily to assure the desired tooth bearing contact. All bevel gears are run through the Gleason gear testers.

Quality control activity stems from the gear laboratory whose function it is to check new gears, to check gears in experimental production, to assist in trouble-shooting whenever difficulties arise in the production department. The gear lab is superbly equipped with the latest types of inspection devices including a new Bausch & Lomb gear comparator with magnification up to 100 diameters; Illinois involute checking machines with the recording chart attachment; Illinois machines for checking tooth spacing; Red Ring checking machines; Gleason bevel gear checker, etc.

In addition, the production inspection department has Red Ring gear checking machines, Fellows Red Liners, Illinois checking machines, and other items of equipment.

Now as to a generalization of the gear cutting procedures used in this case. Although several specific examples have been given in the routings, it is helpful to visualize the general character of the process. In the first place, all bevel gears are cut on Gleason generators, using the latest type two-tool machines. Fellows gear shapers of various sizes are used for cutting all internal and external splines and for shoulder gears which cannot be handled with facility in the hobbing machines.

With the wider application of the Red Ring shaving process employed, the practice with respect to the finishing of spur gears has taken several directions. The spur gears all are hobbed on Cleveland hobbing machines but the routing depends upon the finishing process. Originally all spur gears were finished by grinding. In these cases, the gear teeth are hobbed in the green, then precision-ground on Pratt & Whitney or Detroit Gear grinders after heat treatment.

However, with the accelerating effect of the national defense program, it has been necessary to draw upon other of gear finishing techniques so as to supplement the production equipment available for the purpose. With this as a starting point, the production department investigated other gear finishing processes and found that SHAVING produces gears of excellent quality, meeting the most exacting specifications. Fortunately, the shaving machines have been available and have made it possible to round out the equipment needs at a time when it is quite difficult to obtain gear grinders.

For the variety of gears that are shaved at this plant, the general procedure is to rough-hob in the green, then carburize and anneal, then finish-hob, and finally to shave on Red Ring machines. Due to the extremely fine tolerances to which the gears are processed, minute variations that would have no meaning whatever in ordinary gear production assume significance here. For this reason, a certain percentage of the shaved gears are lapped after final heat treatment to eliminate minute errors. This is considered purely as a corrective treatment. And the percentage of gears thus treated is steadily decreasing as time goes on.

The important point is that for the first time in aircraft gear practice the gear shaving procedure has had an opportunity to demonstrate its effectiveness. To this extent, this company has contributed greatly to the productivity of the airplane industry.

It is of interest to note that in the gear shaving process the form of the circular cutter is so modified as to compensate for the distortion usually encountered in heat treatment. Due to differing service requirements, there are used two types of heat treatment—gas carburizing for the AMS 6250 gear

High Speed Automatic
SHELL-BANDING MACHINE

FOR 20 MM. TO 75 MM. A. P. OR H. E. SHELLS

Operator drops shell and band into the "nest", presses a button, the machine squeezes the band in place and ejects automatically. One, two, three, or four squeezes can be selected, with automatic indexing between squeezes to permit uniform metal flow, prevent crystallization of the copper, and provide thorough penetration into the serrations. First stroke, when two or more are used, is a partial squeeze to flow the ring to top of serrations. Pressure can be closely regulated to suit a variety of conditions. Production obtainable depends on the efficiency of the operator in loading. Cycle of one stroke is 1½ secs.

CAPACITY - 37 MM. SHELLS
600
PER HOUR

20 MM. SHELLS
1200
PER HOUR

The R-J Shell-Banding machine is hydraulically operated with electric controls. It will handle all sizes of projectiles from 20 mm. to and including 75 mm. size, either armor-piercing or high-explosive types. It can be changed over from one size to another in less than 15 minutes. Equipped with a 10 h.p. motor and takes floor space of 36" x 72".

We specialize in the design and manufacture of distinctive production machinery and are seeking opportunities to help you obtain greater production at lower unit cost.

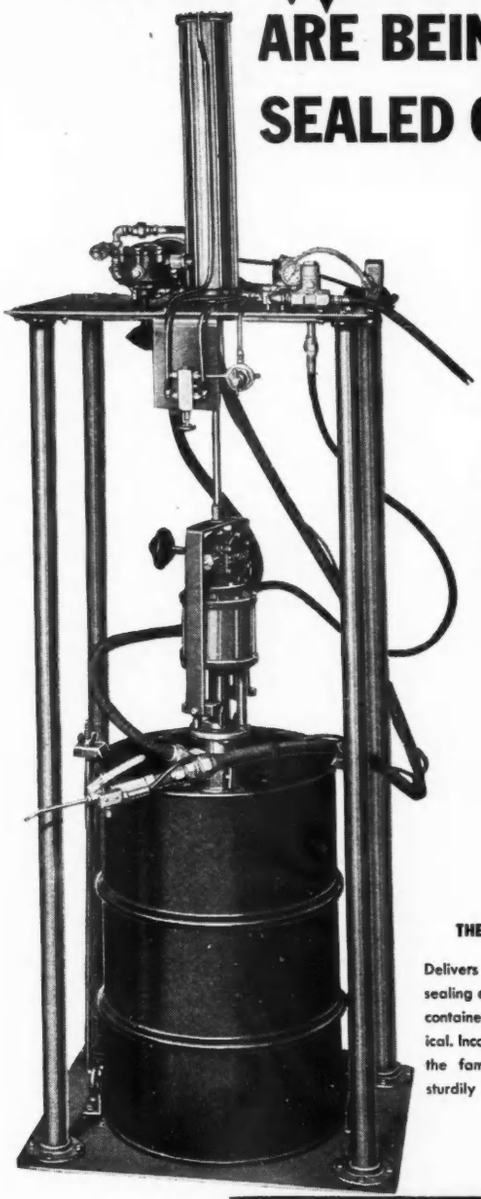
REHNBERG R-J JACOBSON

REHNBERG-JACOBSON MFG. CO.
Special Machinery
2137 KISHWAUKEE ST. • ROCKFORD, ILLINOIS

M3 MEDIUM TANKS

ARE BEING SEALED ON THE PRODUCTION LINE WITH

The LINCOLN "PILE DRIVER"



Today, with speed and efficiency the "watch-word" in war production, the old and slow putty-knife method of applying sealing compound to the connecting surfaces of armor plate in tank construction hampers production.

In one of the large tank manufacturing arsenals, production engineers have found that the Lincoln Pile Driver is the war-time answer for—Dispensing sealing compound from original containers . . . Applying it with greatly reduced man-hours . . . Doing a faster and much better job . . . Eliminating waste of material, and have adopted it for production line service to replace the out-moded putty knife.

WAR DEMANDS HAVE CREATED MANY NEW USES FOR LINCOLN EQUIPMENT

Lincoln Lubricating Equipment is now being used extensively in the armed forces—air, electric and gasoline powered, portable and stationary lubricant pumps . . . hand operated grease guns and grease fittings are only a few of the Lincoln products that are helping in the "all out" program. If yours is a problem in dispensing lubricant or sealing compound, consult our engineering department. They will gladly work with you and make suggestions.

THE LINCOLN "PILE DRIVER"

Delivers heavy viscous lubricants or sealing compounds direct from original containers. Fast, positive and economical. Incorporates all of the features of the famous Lincoln Lubrigun and is sturdily built for heavy-duty service.

LINCOLN CENTRO-MATIC LUBRICATING SYSTEMS

Provides speedy and positive lubrication of all bearings on machinery and mechanical equipment. The system is easy to install and consists of a number of Centro-Matic injectors—one for each bearing, each individually adjusted to discharge the required amount of lubricant. Lubricant is delivered under pressure, to the bearings from a central pumping unit, which can be either hand operated, semi-automatic or entirely automatic with time clock control.

141-19

LINCOLN ENGINEERING COMPANY

Pioneer Builders of Engineered Lubricating Equipment

ST. LOUIS, MO., U. S. A.

steels, and nitriding for certain gears which require an extremely hard surface.

If a shaved gear is examined before heat treatment, it will not conform to the true involute proportions established by specifications. But during heat treatment it "distorts" to precisely the specified form. The key to this is found in the initial experimental work by the gear experts—the checking of the average distortion of each type of gear due to heat treatment, and the development of cutter form for each type of gear so as to produce the desired correction in the shaving machine.

While on the subject of heat treatment, it is of vital importance to note that control of the quenching operation holds the key to the ability of producing precision gears. Reference to the gear drawings will show that the blanks are exceedingly slender and have many critical changes in section volume. Moreover, many of the blanks have large gear ends combined with long and slender hubs. The only way that has been found to hold these gear blanks in accurate alignment and without distortion is by die-quenching. Consequently, each of the gears, regardless of dimensions, is die-quenched in the familiar Gleason machines, using specially designed dies. These dies are massive to prevent distortion or drifting of the blank form, but above all they are so designed as to make it possible to load the heated blank quickly so as to prevent differences in temperature from further complicating the process.

This company also has introduced another technique which holds considerable interest. This is the shot-blasting of gear blanks, using an adaptation of the familiar American Wheelabrator. This operation does not affect the form or size of the gear teeth, but it does produce the initially stressed skin that contributes to a large increase in fatigue resistance.

BRIGHT FINISH NOT COATED, HOT TIN COATED, ELECTRO COATED WITH NICKEL, ZINC, COPPER, BRASS . . .

● Thomastrip is a specialized product made accurately to specification, meeting the most rigid requirements and accelerating production for those making defense parts. Laboratory tests in addition to broad experience and specialization in cold rolling of the most exacting nature enable Thomas to meet these demands. Send sketches, drawings, or write regarding your "all out" products.

THE THOMAS STEEL CO., WARREN, OHIO
SPECIALIZED PRODUCERS OF COLD ROLLED STRIP STEEL

Airbriefs

(*Continued from page* 40)

Landing Gears

In looking over some intimate pictures of the B-19 landing gear a few days ago, I thought of the good old days of the rubber shock cord which, with all of its shortcomings, had a tremendous capacity for taking punishment if properly wound. In the last war the British pilots had a method of torturing landing gears which would promptly "wash out" the modern variety. They used to side slip into small fields, far too short for a straight landing, and stall several feet above the ground, dropping with a bang and very often with considerable side motion. How many of our modern mechanics could wrap shock cord to get that delicate balance between disastrous slack and that too tight condition which wrecked planes with high pressure tires on every takeoff and landing? In the last war the Germans were short of rubber and the "ersatz" shock cord they employed was a spiral steel spring with the braid covering which we used with the rubber. Naturally it had very limited capacity. Of course, many of our modern machines are too heavy for shock cord.

Gliders

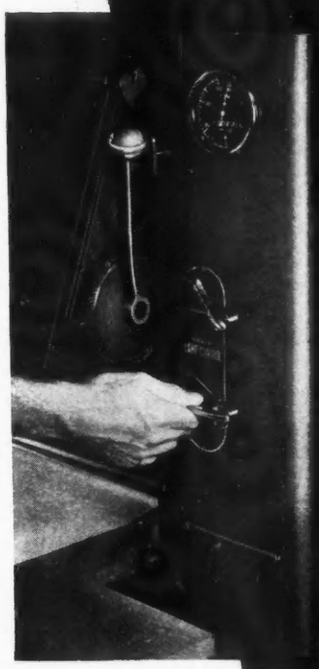
The Army and the Navy seem to be going into the development of gliders seriously and there are rumors of extremely large machines of this type to be built. The glider certanly has a vital place when used in a surprise attack in bad weather. In fact, the use of drifting balloons to land troops in Britain from the French coast was presented to Louis XVI before the French Revolution. The projected use of low-powered planes for this purpose could never achieve the same ends, although low-powered planes with low wing-loading, which could gain altitude and then glide in with a dead engine, might be very useful in certain cases.

BLUEPRINTS AT *Thirty Feet* PER MINUTE WILL *Speed* YOUR PRODUCTION

American Industry, geared to fill larger and larger orders, is taxed to its utmost to meet new and constantly changing specification demands...faster production...faster delivery.

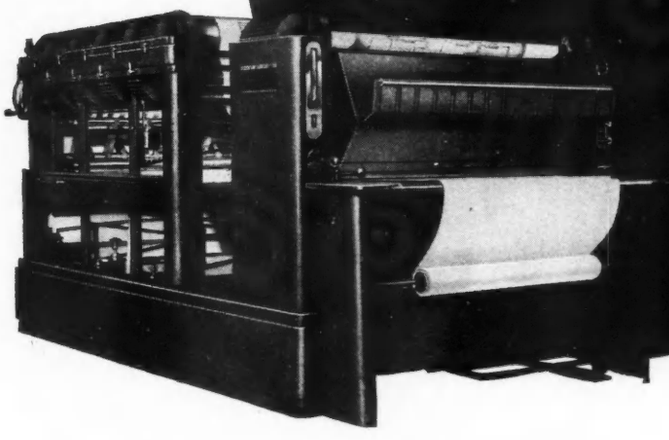
Pease Continuous Blueprinting Machines effectively bridge the gap between engineering and production departments...There is no costly "time out" waiting for blueprints... because, for example, Pease Model "22," illustrated, using fast blueprint paper and good tracings produces quality blueprints at a speed of 30 linear feet per minute.

Further: clear, contrasty blueprints can be made from pencil drawings, saving your overworked drafting department many tedious hours of inking in.



THREE SPEED LAMP CONTROL

Exclusive Pease feature allows operation of Model "22" Printer lamps at 10, 15, or 20 amperes at will, eliminating frequent dryer heat changes. Mechanical operating speed remains same while lamp amperage is varied to suit tracings being printed. Convenient dial speed control provided.



Pease Model "22" Continuous Blueprinting, Washing, Developing and Drying Machine. Production Speed 30 feet per minute.

OUTSTANDING FEATURES

- ★ Three Speed Lamp Control (Illustrated)
- ★ Sliding "Vacuum-like" Contact
- ★ Actinic "No-Break" Arc Lamps
- ★ Horizontal Water Wash
- ★ Quick Change Chemical Applicator System
- ★ Thermostatically Controlled Drying Drums, either gas or electric

Pease equipment installed now will meet every challenge for many years to come. Write for literature illustrating and describing our complete line.

THE C. F. PEASE COMPANY
2635 WEST IRVING PARK ROAD
CHICAGO • ILLINOIS

Blueprinting Machines

A TYPE AND SIZE FOR EVERY REQUIREMENT INCLUDING DIRECT PROCESS PRINTING

Service Plans to Help Automobile Dealers

(*Continued from page* 41)

to put it in first-class condition and then a new car guarantee on this work. Buick's CYC program calls for a gentleman's agreement between the dealer and the owner whereby the latter maintains a systematic service schedule as preventive maintenance, with a windshield sticker as a reminder. All the programs emphasize the importance of keeping in contact with customers through direct mail, telephone or personal solicitation, and keeping customers satisfied through properly inspected workmanship, reasonable charges and prompt delivery of service jobs when promised.

Government limitation orders on the manufacture of replacement parts have compelled most passenger car and parts manufacturers to set quota allotments on sales to dealers and distributors. The latest order of the War Production Board requires that a producer shall not manufacture during the first six months of 1942 more than 150 per cent of the number of certain replacement parts sold by him for replacement purposes during the 12 months of 1941. This places parts manufacture for the current six-month period at three times the going rate during 1941. It is designed to build up a stock of parts to last for two years, or until the end of 1943.

Manufacture of replacement parts is scheduled to cease after June 30 in order that machinery, facilities and labor in the parts industry can be converted to war production. Material orders for parts use must be made before June 1 and material deliveries must be completed by June 30. Replacement parts as defined in the order are given an A-10 priority rating. As defined, these include the following functional parts and their components: engine, clutch, transmission, propeller shaft, axles, brakes, wheels, hubs, drums, starting apparatus, spring suspension, brackets and shackles; exhaust, cooling, fuel, lubrication and electrical systems, including generators, lights, reflectors and batteries; gages, speedometers, motors, fuses, flares, directional signals, rear view mirrors, windshield wipers, control mechanisms, steering apparatus and driving gears.

Due to the high production rate that the order authorizes, it is quite likely that some manufacturers will be unable to fill their allotments. A few plants do not have the productive facilities to meet the quotas, although a number can do so by adding second and third shifts, providing labor is available. A bigger drawback will be the shortage of raw materials, especially such critical materials as copper, nickel, lead, rubber and chrome, which certain replacement parts require. Little if any of these critical materials will be available for A-10 priority use, while rubber and copper restrictions would further bar the tripling of production of such items as radiators and radiator hose.

Passenger car manufacturers have the productive capacity to fill their replacement parts quotas if the machinery has not been diverted to war work. Finding the necessary machine capacity available may prove a problem in some plants. The high ceiling on parts output also permits companies to spread the overhead cost among a considerable volume of parts. A single part may require 20 dies, which must be taken out, placed on the machine and then properly set. This requires considerable labor cost, which is the same whether 10 or 5000 of the parts are run off.

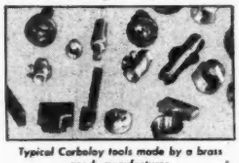
Most manufacturers are continuing to supply their dealers, jobbers and distributors with replacement parts on the basis of their needs, providing they are not out of line with previous orders. This is designed to forestall hoarding.

For Rush Tooling Braze Your Own Carboloy Tools

When you need tools in a hurry—when a job demands immediate tooling—mill, braze and grind your own Carboloy tools! Three simple operations, done in your own tool room—and the tool is on the job. It's *fast*—less than an hour is required for most single-point, straight-shank tools.

It eliminates ordering time and "hold-ups" awaiting deliveries.

Keep a stock of Carboloy Standard blanks in your tool crib . . . ready at a moment's notice to make up tools. You simply recess a shank to accommodate the Carboloy blank—braze in the blank—and grind the brazed tool.



Typical Carboloy tools made by a brass goods manufacturer.

With these three simple steps you're prepared to meet emergency tooling immediately.

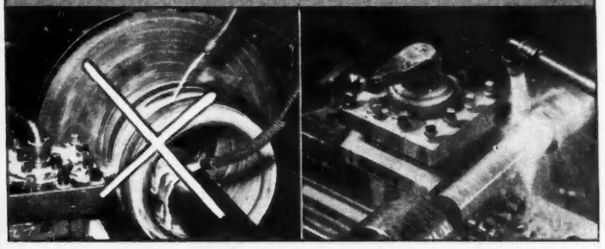
A new 32-page Carboloy Tool Manual, No. GT-133, shows you exactly how to do the job and also

STANDARD CARBOLOY BLANKS

65 SIZES
2 STYLES
3 GRADES

contains data essential for subsequent use and maintenance. This manual, with Carboloy Standard Tool and Blank Catalog, No. GT-140, listing Carboloy Standard Blanks—65 sizes, 2 styles, 3 grades—sent upon request.

When You Use Coolant with Carbide Tools — Use *PLENTY* of It!! —



A weak stream of coolant is ineffective and results in reduced tool life.

An ample volume of coolant at high velocity carries away heat rapidly and continuously.

TO INSURE best results when you use coolants with cemented carbide tools, always provide an ample flow of sufficient volume and velocity to reach, and adequately cool, the cutting edge of the tool. A weak, thin stream may often do more harm than good since the high speeds used with carbide tools—usually above 200 feet per minute—may cause most of the coolant to be carried away from the work before it reaches the point of the tool.

If you want to provide best possible conditions for efficient use of coolants do these two things:

USE VITAL CEMENTED CARBIDES EFFECTIVELY!

1. **Make sure that coolant pump, tank, and supply pipes are of sufficient capacity to maintain large flow at high velocity *without appreciable rise in coolant temperature.***
2. **Make sure that coolant is actually reaching the cutting edge of the tool by providing adequate velocity and directing flow along an unobstructed path directly towards point of tool.**

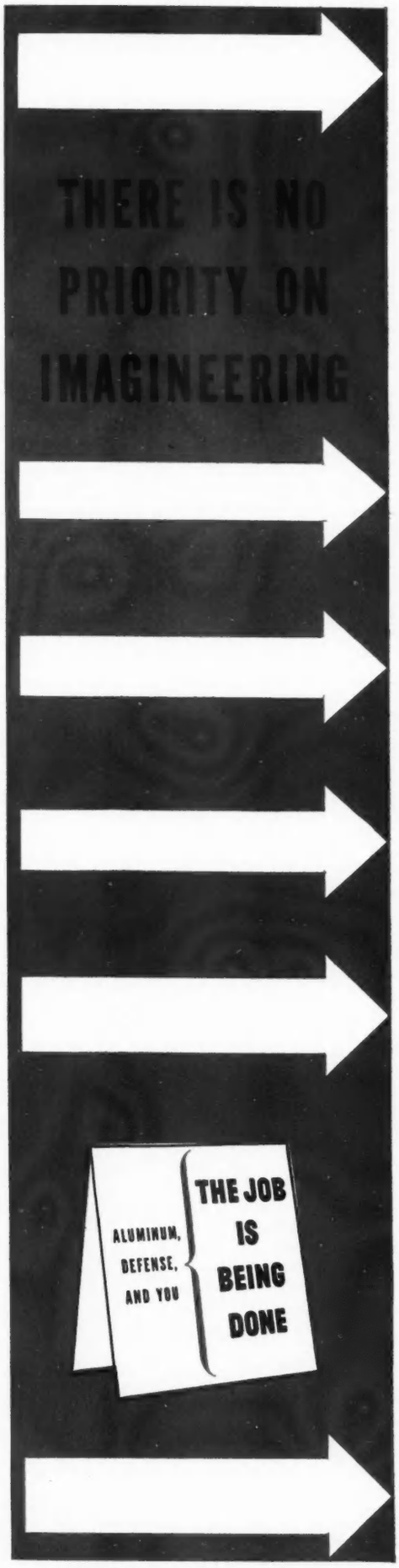
For complete details and sketches, consult page 20 of Carboloy Tool Manual No. GT-133, available upon request, without obligation.

CARBOLOY COMPANY, INC.
11151 E. 8 Mile Rd.,
Detroit, Michigan

Chicago · Cleveland · Los Angeles · Newark · Pittsburgh
Philadelphia · Seattle · Worcester, Mass.

CANADIAN DISTRIBUTOR: Canadian General Electric Co., Ltd., Toronto, Canada.

CARBOLOY CEMENTED CARBIDES
TOOLS · DIES · DRESSERS
CORE BITS · MASONRY DRILLS
· WEAR RESISTANT PARTS ·
FOR THE MANUFACTURING · MINING · TRANSPORTATION · CONSTRUCTION INDUSTRIES



EVERY INDUSTRY, every responsible man in industry, has the present duty of answering two questions.

FIRST ONE IS: Are we, am I personally, doing everything within my power for the war? Our answer here at Alcoa is a plain, unqualified, yes.

NEXT QUESTION IS: What are we doing about the day when we will all need business, which is the polite way of saying, when millions of jobs will be needed for the boys who come back, and for the boys who stayed back to make the weapons.

IMAGINEERING, you know, is the word we have coined to define what we business people have all got to do about the future; about the products we are going to make and the services we are going to be able to offer when this war is over. Imagineering is imagination plus engineering.

HOW DO YOU DO IT? One way would be to figure out, now, how to take advantage of all the aluminum that is going to be available.

QUICKEST WAY TO GET AT IT is to take one of your products or a piece of equipment that "just couldn't" be made of aluminum, and ask yourself, Why not?

MEANING, OF COURSE, why not light; why not stronger for the same weight; why not resistant to corrosion, and so on, ad infinitum. The first man in any line of business who calls tradition a liar, and things-as-they-are a millstone, is the man who is going places; the man who is going to make peacetime pay rolls.

THAT'S IMAGINEERING AT WORK. We've got some ideas here at Alcoa. We're trying to pass them out. We are looking for men who have made themselves receptive by doing some solid Imagineering on their own hook, in their own fields.

Aluminum Company of America, 2110 Gulf Building, Pittsburgh, Pennsylvania.

ALCOA ALUMINUM

Chevrolet stocks its dealers with parts on the basis of their previous 60-day sales records.

One large parts company is allotting its distributors for the first six months of 1942 50 per cent of their total purchases in the 1941 calendar year. The allotment for the second six months of 1942 will be somewhat less than that for the first six months. It is planned to reserve approximately 40 per cent of the stockpile for use after Jan. 1, 1943, which would equal 60 per cent of 1941 sales. This program foresees a gradual reduction in the number of vehicles in service due to the tire shortage. Some sources estimate that as much as 25 per cent of the nation's passenger cars may be immobilized within a year unless the rubber situation is alleviated.

Current replacement part sales are unusually high because owners realize they will have to keep their cars running longer and they are disposed to have repairs made because their income is at a high level. A number of "jalopies" that ordinarily would be scrapped are being kept in service due to the rationing order. There also has been a tendency by certain owners, stimulated by the tire rationing order, to hoard certain parts, such as spark plugs, oil filters and fuel pumps.

Some clarification of the parts limitation order may be necessary in the case of storage batteries, which deteriorate over a year's time. If the 1943 battery supply is manufactured in the first six months of 1942, many of them may be unfit for dependable service when needed.

Manufacturers are continuing to urge their dealers to sell parts, usually at a discount, to the nation's 49,000 independent service establishments. They realize that these establishments play a large part in keeping the nation's automobiles in operation, especially the older models upon which many factory workers and farmers depend for transportation. They also know that these independent repair shops help keep the automobile company customer-owners satisfied with their product.

However, the new car dealers are engaged in a struggle for their economic lives. To exist without benefit of volume new car sales they must increase their service business. This must be done in competition with the independent repair shops. Therefore, many new car dealers will not be disposed to sell parts to these rival establishments at a discount, especially if they are running short of parts for their own use. It finally will rest with the dealer's judgment on how he will handle the situation.

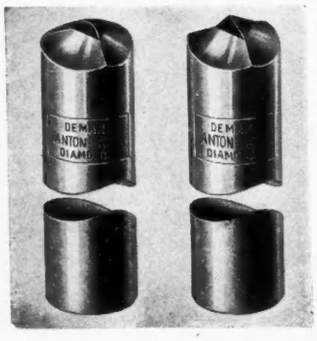
However, independent service establishments buy most of their parts and accessories through jobbers and wholesalers, which will continue to supply them, although under quota restrictions similar to those put into effect by manufacturers. The jobbers and wholesalers also will keep on selling parts to new car dealers as in the past, but on an allotment basis. Possibly the anticipated curtailment in car use will help solve the problems of parts distribution and leave plenty of replacement parts to "keep 'em rolling."

INDUSTRY DEMANDS MORE

ASCO

DIAMOND TOOLS

So- WE TAKE A LARGER PLANT!



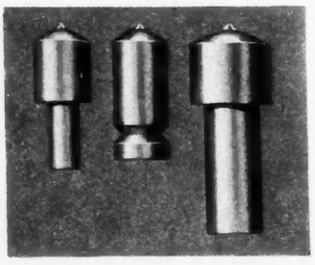
Because War Production requires full capacity from every machine 24 hours a day, more and more defense plants are calling for more and more "Asco" Diamond Tools. To meet this increased demand, we have moved to new and larger quarters at

333 WEST 52nd ST., NEW YORK, N. Y.
Telephone: COLUMBUS 5-5395

Here, greatly enlarged facilities have stepped up production and permit us to serve you better and faster on all "Asco" Diamond Tools, or to supply you with loose Bortz, Ballas and Carbons in all sizes and grades. Let us know your requirements. Send blueprints of special shaped tools for quotation. Write for detailed, illustrated folder.

Above: Shaped Cutting Tools for Turning, Boring, Facing.

Right: Landis Nib, Norton Nib, Cincinnati Nib for truing and shaping grinding wheels.



DRESSING TOOLS • WIRE DRAWING DIES • CORE BITS • PHONO POINTS • WRITING PENCILS
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IMPORTERS OF INDUSTRIAL DIAMONDS—BORTZ, CARBONS AND BALLAS.
MANUFACTURERS OF ALL KINDS OF DIAMOND TOOLS.

Truck Tire Sizes Being Standardized

The rubber industry is conserving its supply of standardizing truck tire sizes. Combination of balloon and high-pressure casing tires or elimination of the high-pressure type has halved the former size range.

The B. F. Goodrich Co. has developed 11 combination sizes to do the work of 28 formerly used. Similar simplification of truck tire sizes was reported by Goodyear Tire & Rubber and Firestone Tire & Rubber.

Ludlum Scrap Department

A new scrap and salvage department has been created by the Allegheny Ludlum Steel Corp., located at the company's Brackenridge, Pa., plant under the management of E. L. McGraw.